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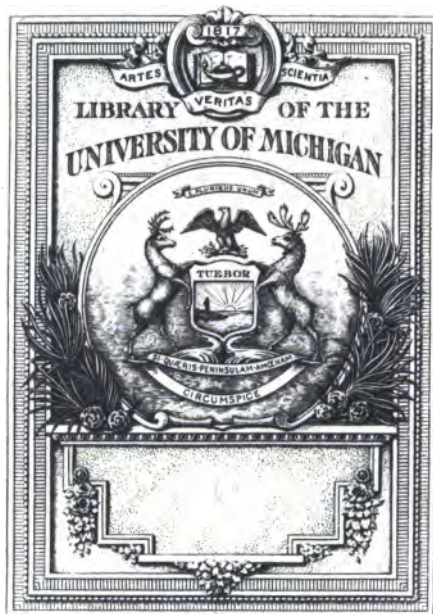
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Trans. for
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IMPROVEMENT

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OF THE

St. Mary's River and Canal

MEMORIAL TO CONGRESS,
OFFICIAL HISTORY OF THE IMPROVEMENT,
COMMERCIAL STATISTICS FOR 1878.

PRINTED BY ORDER OF

The Marquette Iron Ore Association

MARQUETTE:
MINING JOURNAL STEAM PRINTING HOUSE.
1878.

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Sept

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ROOMS OF THE MARQUETTE IRON ORE ASSOCIATION,
Marquette, Lake Superior, Michigan,
February 11, 1879.

At a meeting of this association, held this day, to consider the report of the committee on Statistics, it was unanimously

Resolved, That the President and Secretary be, and they are hereby, authorized and directed to procure the printing of 500 copies of the memorial, submitted by the committee on statistics, and adopted by this Association, together with the commercial statistics and official history of the improvement of the St. Mary's river and canal, and to present the same to Congress at the present session.

Attest:

DAVID MORGAN,
President.

C. Y. OSBURN,
Secretary.

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MEMORIAL.

*To the Honorable the Senate and House of Representatives
of the United States, in Congress assembled:*

Your memorialist, The Marquette Iron Ore Association, of Marquette county, Michigan, respectfully calls the attention of Congress to the condition of St. Mary's River, through which all Lake Superior commerce passes on its way to market.

This river is the water-link between Lakes Huron and Superior in the chain of the great lakes. It is 75 miles long, and is the boundary line between the United States and Canada. It flows southeasterly, between 45° and 47° north latitude. For most of its length it is navigable and of sufficient depth to float the largest lake vessels. Occasional impediments to navigation are found, which have been partially removed. Congress has heretofore made appropriations to improve the river. At this time, an admirable engineering work—the canal around St. Mary's Falls—is being done by the general government, which when completed will contribute materially to the growth and development of the northwest, inasmuch as it will reduce the cost of transportation, and greatly facilitate business.

In 1852, Congress donated to the State of Michigan 750,000 acres of lands to build a projected canal one mile in length around the St. Mary's Falls, and with two locks. A company was organized with sufficient capital to carry the enterprise to completion in 1855. It was built to ac-

commodate the then lake marine, and no one possessed the prescience to foresee the advancement that time would bring in lake craft. Other improvements made under appropriations of Congress—notably the St. Clair Flats Canal—permitted the employment of vessels of greater carrying capacity, and vessel builders have met the needs of trade by an increase in the tonnage of vessels. The canal, as originally constructed, permitted the passage of vessels of 12-foot draft, and the river was in several places dredged to the same depth. Subsequently it became manifest that the depth of the canal and the locks no longer accommodated the vessels in trade on the lakes; accordingly, Congress approved of a plan for a new system of lockage alongside of the old locks, by appropriating \$150,000 to begin the work of enlargement. The work has been continued under other appropriations from 1870-'78, and it is now believed will be completed in 1880.

The dimensions of the new locks are: Length, 515 feet; breadth, 80 feet; depth, 16 feet. With this work is involved the deepening of the canal above and below the locks, which has been carried on contemporaneously with the work on the new lock; and, therefore, the canal, including lockage, will probably be ready to pass the larger vessels of the lake fleet during the season of 1880.

For a more comprehensive account of the origin and progress of this national work, your memorialist begs leave to refer to the annual reports of the Engineer officers in charge, from 1866 to 1878, which accompany this memorial.

Congress has provided all the funds employed in digging this artificial water-way. Michigan was entrusted with the original appropriation, and has executed the trust. Notwithstanding the fact that the general government supplied all the money necessary to build the original canal, and has also appropriated the requisite funds to construct the new canal, the State of Michigan still retains possession of the canal, and, to cover operating expenses, imposes upon the commerce of the lakes a toll of three cents per registered ton. During the years since the opening of the canal to the

close of last year, according to the report of the Superintendent to the State Board of Control, this burden upon the products of the country dependent upon the canal to reach a market, has grown to be \$696,243. Out of this onerous tax upon a hitherto limited territory, the State has made such repairs as were needful; but the industries of a struggling new territory have nevertheless been compelled to bear this burden. However, the State of Michigan, recognizing the national importance of the canal, and, as an inducement to Congress to further improve it, at the general session of its legislature in 1869, passed the following:

"Joint Resolution authorizing the Board of Control of the St. Mary's Falls Ship Canal to transfer said Canal to the United States.

"WHEREAS, The immediate enlargement of the St. Mary's Falls Ship Canal, by which Lake Superior is rendered accessible to vessels, is a work of urgent necessity and national importance; and, whereas, the State of Michigan has no funds properly applicable to such purpose;

"Resolved by the Senate and House of Representatives of the State of Michigan, That the Board of control of the St. Mary's Ship Canal be, and it is hereby, authorized and directed to transfer said canal, with all its appurtenances, and all the right and title of the State of Michigan in and to the same, to the United States; *Provided,* This State shall be first guaranteed and secured to the satisfaction of said Board of Control against loss, by reason of its liability upon the bonds issued under and by virtue of an act entitled 'An act to provide for the repairing, preservation, and operation of the Ship Canal around the Falls of the St. Mary's, and to perform the trust respecting the same,' approved February 14, 1859.

Approved April 3, 1869.

The grant as above made has remained inoperative because the United States have never accepted the grant.

Governor Crosswell, in his last message to the Michigan legislature, on the opening of the current session, thus speaks of the canal:

"The 23d day of June last, marks a quarter of a century since ground was broken for the construction of the St. Mary's Falls Ship Canal. The tonnage passing through it has increased from 106,296 tons in 1855, to 1,439,215 tons in 1877, and 1,667,136 tons in 1878.

"Its gross yearly revenues during the same time have multiplied by ten, being \$44,351.43 in 1877, and \$49,437.00 in 1878. More than 5000 vessels, many of them of large tonnage, have passed its locks in the the two seasons referred to, making an average passage of one boat every two hours and ten minutes during the time of navigation. The general government is now building additional locks for the purpose of enlarging and increasing the capacity of the canal, and such progress is being made that the work promises to be fully completed within the next two years. The Legislature of 1869, by joint resolution, authorized the Board of Control to transfer the canal to the United States on the payment of all out-standing indebtedness incurred by the State in the construction or management thereof. The indebtedness of the canal, which the State treasury is pledged to pay, is \$46,000.00, and the amount standing to its credit on the books of the Treasurer, is \$74,532.12. The canal debt is thus fully provided for, and will be extinguished as rapidly as it falls due and before, if the bonds can be purchased.

"The projection and construction of this canal is eminently due to the sagacity and exertions of the early settlers of Michigan. They knew that the extensive coast of Lake Superior possessed mineral and other treasures of great value, and with almost prophetic vision they seemed to realize the importance of the immense commerce and trade which has since been developed in this region. Through defeats, delays and discouragements they steadily persevered in urging the enterprise until they were effective in securing its commencement and completion. It would most fittingly crown their achievement if this important channel, opening complete water communication between the greatest of inland lakes and the ocean, were made forever free to the passage of all vessels navigating these waters. If this were accomplished, and reciprocal facilities afforded us by the dominion of Canada for transportation through the Welland canal, the entire passage from the great lake to the ocean would be untrammelled by tolls, and the commercial and social relations of prosperous communities, speaking the same language and having many interests in common, improved and strengthened."

At the present session of the Michigan Legislature a joint resolution of the following tenor has been introduced, passed the House, and is pending in the Senate. It will doubtless pass and receive the Governor's signature:

"WHEREAS, The advances heretofore made by the State of Michigan to aid in the construction of the St. Mary's Falls Ship Canal have been fully repaid by the receipts of tolls,

"AND WHEREAS, The work is of great national importance, and upon which several million dollars have been expended by the United States,

"AND WHEREAS, It is deemed that the best interests, not only
"of this State, but of the entire commerce of the lakes, will be pro-
"moted by having this great public improvement under the imme-
"diate supervision of the general government, thereby rendering it
"free to all American vessels, therefore

"Resolved, By the Senate and House of Representatives of the
"State of Michigan, that the Board of Control of the St. Mary's
"Falls Ship Canal, be and it is hereby authorized and directed to
"transfer the said Canal with all its appurtenances, and all the
"right and title in and to the same to the United States.

"Resolved, That our Senators be instructed and our Represen-
"tatives be requested to use their influence to secure such action
"upon the part of the General Government as may be necessary
"to affect this transfer."

It now only remains for Congress, by appropriate legisla-
tion, to accept the grant of the canal made by the State, and
your memorialist urgently petitions Congress to notify the
State of the acceptance of the grant by the general govern-
ment, in order that, by the abolition of all tolls, the canal
may be declared to be a great national and international
thoroughfare. The money statement shows the canal's
indebtedness to be fully provided for; in fact, there is a
credit balance, over and above all liabilities, on the books of
the State treasury, of \$28,532.12; and, therefore, Congress will
not be required to secure the State against loss on account
of its endorsement of Canal bonds, as provided in the joint
resolution of 1869 as a condition precedent to the cession of
the Canal.

Your memorialist respectfully represents, that, though, by
Congressional aid, a canal around the St. Mary's Falls will
soon be finished that will accommodate the largest of lake
vessels, the river, both above and below the canal, is shoal in
certain places; and, in order that the full benefits of the new
canal may be derived, the Congress is earnestly petitioned to
appropriate the sum of twenty thousand dollars and to direct
that an accurate survey be made of the river with a view to
securing a channel navigable by vessels drawing sixteen feet.

Your memorialist also petitions Congress to make an
appropriation sufficient to improve the river at certain points
above and below the canal, so as to meet the immediate
demands of commerce, believing that an expenditure could
be profitably made under the direction of the War Depart-

ment, before a survey is completed. In low stages of water vessels drawing no more than twelve feet have grounded above the canal; and dangerous shoals and projecting reefs in or near the regular channel of the river below the canal, imperil the navigation, and often cause disaster. Engineers of the army are sufficiently familiar with the most dangerous places to at once proceed to remove obstructions without materially increasing the cost beyond what will be required after a survey has been made.

At a regular meeting of this Association, a committee was appointed to collect commercial statistics of the south shore of Lake Superior. The effort has been only partially successful; but such statistics as have been received at this time are herewith submitted, and reference is respectfully made to tables subjoined as evidences of the commercial importance of the canal and river. But the statistics herewith submitted do not fully represent the traffic, much less do they show the probabilities of the future. Besides the states of Michigan, Illinois, Indiana, Wisconsin, Ohio, Pennsylvania and New York, whose people are nearly connected with the traffic passing the canal, the north and south shores of Lake Superior, and that far stretch of agricultural territory lying north and west of the head of Lake Superior, are almost wholly dependent upon the St. Mary's river improvements for an outlet. The natural water way provides reasonably cheap means of transportation, which is the basis of the present and future development of the regions specified. Indeed, without a water channel to the markets of the world, it is doubtful if the great wheat producing region of upper Minnesota, Dakota and Montana could freight their products to market at all. It can hardly, therefore, be disputed that the past and future growth of that region depends upon the means afforded for transportation. The same is true in a pre-eminent degree of the iron, copper and lumber regions of Lake Superior. Until the completion of the canal in 1855, substantial progress, even in the richest mineral districts, was impossible, and since that date the public wealth has been augmented many times beyond the cost of any past or projected water-way improvements.

A brief comparison of facts will show the necessity for the improvement your memorialist prays for, viz.: The deepening of the St. Mary's River.

Economical transportation demanded a larger class of vessels on the lakes. A greater carrying capacity lessens the expense of labor and time while in transit, and the lower lakes are now provided with freighting vessels of much larger tonnage than could be formerly employed.

Lake Superior is excluded from employing the largest of lake craft, except at a loss, because of the insufficient depth of water in the St. Mary's River. Moreover, the exceedingly tortuous channel of the river causes delay as well as increases the perils of navigation. These two natural defects enhance the freight rates, and, in that respect, are burdens upon the products of the country stretching fully 1,500 miles westward of the St. Mary's Falls Canal.

To illustrate this fact practically, a compilation of the average annual lake freight rates on iron ore between Escanaba, Michigan, and Cleveland, Ohio, and Marquette, Michigan, and the same Lake Erie port, has been made.

The table has been compiled with the utmost care from actual transactions of the years 1870 to 1878, and the conclusions accurately show the additional cost per ton the present shallow river entails upon Lake Superior products. Escanaba, situated at the head of Green Bay, (Lake Michigan, is nearly as far from Cleveland, Ohio, as is Marquette—the difference in distance would not add perceptibly to the cost of freight. The shipping facilities are about equal at both shipping points.

Table showing the average of lake freights on iron ore from Marquette, Lake Superior, and Escanaba, Lake Michigan, to Cleveland :

YEARS.	Season average per ton from Marquette.	Season average per ton from Escanaba.	Difference in favor of Escanaba.
1870.....	\$ 3.00	\$ 2.32	.68
1871.....	2.73	2.11	.62
1872.....	3.04	2.36	.68
1873.....	3.00	2.12	.88
1874.....	2.38	1.76	.62
1875.....	2.32	1.61	.71
1876.....	1.66	1.09	.57
1877.....	1.60	.99	.61
1878.....	1.35	.90	.45

The average rate paid for the nine years is 64 $\frac{1}{2}$ cents more per ton of iron ore shipped by Lake Superior shippers than the amount paid by Lake Michigan shippers on the same commodity for practically the same distance.

In other words, for example, while it cost consumers of iron ore shipped from Marquette through the St. Mary's Canal, for lake freight, on 555,750 tons shipped by lake and river in 1878, an average of \$1.35 per ton, or \$750,262.50, it would have cost consumers on the same number of tons from Escanaba, at the average rate of 90 cents per ton, the sum of \$500,175, or \$250,087.50 less for the year. Again; in the year 1877, Marquette shipped to lower lake ports *via* St. Mary's River and Canal, 568,082 gross tons of ore at an average lake freight of \$1.60 per ton, at a cost of \$908,931.20, while the same number of tons could have been transported from Escanaba to the same lower lake ports, at an average cost of 99 cents per ton, or \$562,401.18, being a difference against the canal route of \$346,530.02, on the single item of iron ore for one year. During the nine years, 1870-'78, perhaps the majority of the larger vessels have been launched; and, for the same period of time, there have been shipped from the port of Marquette 4,540,235 gross tons of iron ore and 197,682 gross tons of pig iron,

making a total of 4,737,017 gross tons of freight, on which the average increase of cost over Escanaba rates has been paid by the consumer, amounting to \$3,063,852.99! These figures are made even more astounding when the total tonnage of the canal traffic is taken into consideration, for substantially the same increased cost must be paid on all commodities passing the canal, including copper, wheat, flour, and all the various products of the vast region contributing freight to that route, as well as all supplies coming into the lake region.

This difference in lake freight may be further elucidated by the statement that the ore shipped *via*. Escanaba can be carried enough cheaper by lake than from Marquette to lower lake ports, to bear transportation by railroad a distance of 63 miles from the mines to Escanaba, against 12 miles of railway to Marquette.

It might appear to one not familiar with the circumstances surrounding and affecting lake navigation, that the canal, with this record against it, had better be destroyed than improved; that it has not and does not encourage the development of the immense territory tributary to its traffic. But the difference in cost of freight can be satisfactorily explained, and the explanation will be convincing proof that the new canal and river improvements asked for are wisely economical, and that the total expense incurred, and to be incurred, will within a few years be more than met by the saving in freight rates the improvements will secure to the people.

The integrant parts of the extraordinary expense borne by Lake Superior products above alluded to are three in number.

Attention is first directed to the tolls charged by the State of Michigan on the registered tonnage of vessels, as an element of the extraordinary cost of freight through the canal. Vessels in the ore traffic, as a rule, are not supplied with up freight, and consequently charge the tolls both ways against the ore shipment one way. Thus, the tolls really amount to six cents per ton on the ore, unless a vessel can load deep enough to carry a greater number of tons of freight than

she registers. Usually, sailing vessels carry a greater number of tons of ore than the tonnage measurement would indicate, but steamboats carry less than they register to carry; so that the average tolls on a ton of ore will be within a fraction of six cents, which ore from Escanaba, as it does not pass the canal, is not required to pay.

Second. As the channel of the river is exceedingly tortuous, narrow and dangerous to navigate, delays are caused at night, and to provide against contingent delays from this cause a slight advance in the rate of freight is charged by vessel owners.

Third. But the chief cause of the extraordinary difference in freight charges herein exhibited is found in the shallow channel of parts of the river. As before mentioned, the larger vessels, drawing more than 12 feet, are prevented from loading to full depth. Accordingly, vessels engaged in the Marquette ore trade make their trips with only a fractional part of a load, as compared with the deeper laden vessels in the Escanaba trade, or in the trade of the lower lakes; but the expenses and time of the trips are not correspondingly curtailed: consequently, all of the elements of expense attending freighting—including the time of employment of the vessel, wages of seamen, etc., etc.—are spread upon a less number of tons, where vessels are limited as to draft, than would be the case if full loads could be carried. Comparison of the lading of vessels at Escanaba to 14 feet depth with those at Marquette to 12 feet depth, demonstrates the difference in quantity to be fully 25 per cent. In other words, a vessel which can with 12 feet draft carry 1000 tons through the canal and river, will carry from Escanaba, in the same time and with no greater expense to the vessel, 1250 tons. The per cent. of difference between 12 feet depth and 16 feet,—the depth of the new canal—would be progressively greater than above noted between 12 feet and 14 feet, and accomplish a greater reduction in freight rates. The expenses of the vessel in time, wages, etc., from Cleveland to Marquette and return, are spread upon 1000 tons of ore; while expenses for the same length of time, wages, etc., in going to and from Escanaba, are spread upon 1250 tons.

The result is that it costs less per ton to transport ore from Escanaba to lower lake ports than it does from Marquette to the same ports, or an equal distance, because the depth of water in the St. Mary's river is insufficient to pass full laden vessels.

Congress, for the reasons above set forth, is urgently petitioned to promote the welfare of the people, especially of the inhabitants of the far northwest and those residing on the borders of Lake Superior, all of whom are dependent upon cheap transportation for the development of the resources of the region seeking the world's market through the northern waterway, by accepting the grant of the canal from the State of Michigan, and by appropriating sufficient funds to accomplish the following objects:

1. The completion of the St. Mary's Canal improvement now under way.
 2. The survey of the river.
 3. The deepening of the river in order that the people may avail themselves of the invaluable canal improvement.
- And your memorialist will ever pray, etc.

THE MARQUETTE IRON ORE ASSOCIATION,
BY DAVID MORGAN,
President.

C. Y. OSBURN,
Secretary.

OFFICIAL HISTORY
OF THE
IMPROVEMENT OF
ST. MARY'S RIVER ~~AND~~ CANAL,

1853—1878.

Legislation for the Survey and Improvement of the St. Mary's River and the Improvement of the St. Mary's Falls Canal from the Beginning in 1853, to 1866.

Act approved March 3d, 1853.

For continuing the survey of the northern and north-western lakes, including Lake Superior, fifty thousand dollars; *Provided*, That a survey of so much of the communication between Lake Huron and the Sault St. Marie as may be necessary to ascertain what part thereof requires to be deepened, shall be made without delay, and plans and estimates of the nature and expense of the work shall be laid before congress at its next session.

Act passed Senate July 7th, 1856, and House July 8th 1856, over president's veto.

Chap. 55.—An act making an appropriation for deepening the channel over the flats of the St. Mary's river, in the State of Michigan.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the sum of one hundred thousand dollars be, and the same is hereby appropriated towards deepening the channel of the St. Mary's river, in the State of Michigan, by the west channel, through Lake George, according to the estimate of Captain Macomb, of the topographical corps, communicated to the Senate in the report of the secretary of war, dated January eighteen, eighteen hundred and fifty five; *Provided*, That the dredging machine purchased for the improvement of the St. Clair flats may be

employed when not required therefor, at the discretion of the secretary of war, in the improvement of the St. Mary's river or strait.

Act approved June 23, 1866.

For improvement of the Saint Mary's River, between Lake Superior and Lake Huron, fifty thousand dollars.

NOTE—Subsequent legislation appears in the reports of the engineer officers in charge, from 1866 to 1878, inclusive.

A

Report upon the Improvement of the St. Mary's River, by General T. J. Cram, Colonel of Engineers, U. S. A., for the Fiscal Year Ending June 30, 1866.

I. HISTORY OF THE IMPROVEMENT HITHERTO MADE.

Besides the ship canal at the Sault St. Marie, which was constructed by a private corporation from public lands appropriated by Congress, it is well known improvements were made below the falls under the superintendency of Capt. Whipple, corps T. E., from an appropriation of money by Congress in 1856, of \$100,000.00.

With this, two places were partially improved, one being the channel at the lower end of the expansion known as "Lake George," and below the falls about 20 miles, and the other place the west channel of East Neebish rapids, (see sketches A and B*) which rapids are about five miles farther down the river.

It seems that Congress made this appropriation and trammeled it with the condition that it should be expended in the west channel of said lake, where, as nearly as I can make it out, about \$27.263 was expended in dredging up to the 12th of June, 1858, when, on a recommendation of a Board, congress having untrammeled the remainder of the appropriation, the "middle channel," developed by a survey

*NONE of the maps, plats, charts or drawings, submitted by the officers in charge and referred to in their reports, accompany this publication.

of 1857, was adopted and the west channel abandoned.

The dredge commenced work in the middle channel June 14th, 1858, and continued to work until 6th November, same year, having excavated 90,123 cubic yards, giving a channel of from 100 to 135 feet in width at the top of the slopes, about one mile in length and 15 feet deep.

In the season of 1859, about 15th May, the dredging was commenced again, and continued until 23d July of that year, when the appropriation had become very nearly exhausted, and further dredging was suspended, having expended in this channel, as near as I can make out, about \$69,188.40. Captain Whipple reported the general width of the cut then at 150 feet, except for a distance of five hundred feet, where it was only 125 feet wide, and the depth of water to have varied from 14 to 18 feet, and no sounding was less than 14 feet, in the extent of 5,200 feet. Since that report, no work has been done in this channel. Also, in 1858, the west channel of the East Neebish rapids was improved, (see sketch B.) These rapids are formed by a reef of boulder-rocks, heaped in the middle of the river and spread out to the right and left, leaving a narrow passage near the east and also one near the west bank of the stream. As near as I can learn, about 300 cubic yards of rock was removed leaving a channel 80 feet wide, with a depth, "not less anywhere in it could be found," than 14 feet. The dangerous rock upon which so many steamers had struck then was also removed. The improvement of this channel, as near as I can figure it in the absence of precise data, cost about \$3,000. The foregoing sums, with the small balance of \$148.60 on hand when Captain Whipple made his last report, in 1861, make up the whole of the one hundred thousand dollars first appropriated, of which sum there appears to have been paid for useless work in the west channel of Lake George, \$27,663, before it was abandoned and the dredges put into the middle and straight channel.

After starting the work in the middle channel, it seems to have been the settled design to dredge it with what

money was left, and, by additional appropriation, to a width of 300 feet, and to a depth of 14 feet, for an extent of 5,200 feet; and to dredge or excavate the west channel of the East Neebish rapids to a width of 100 feet, and to a depth of 17 feet. After the first appropriation was exhausted, and in 1858-59-60, Captain Whipple estimated the cost of completing the middle channel at \$71,010.00 putting the dredging of the hard at 91 cents and the soft material at 37.4 per cubic yard and contingencies at 10 per centum; and I find from his estimates the proportion of the hard was about 7 per cent. of the whole amount to be dredged. He also then estimated the cost of completing the west channel of the East Neebish rapids at \$14,290.00, putting the price of the excavation at \$11 per cubic yard for 1,181 cubic yards, and the contingencies at 10 per cent. It is to be understood, of course, that those estimates were made upon prices ruling in 1858-59-60, and upon what the experience of two to three seasons' work had taught the officer in charge. Having confidence in his estimates, I do not hesitate to adopt them as a proper and safe basis upon which to predicate my own estimates, varying the prices, however, to meet the changes which have occurred in rates since those estimates were made, and distributing or modifying the amount of the work I shall propose to be done according to my own judgment as to the present and future wants of this highly important channel of our lake commerce.

II. CHANGES IN THE MIDDLE CHANNEL SINCE THE DREDGING WAS SUSPENDED 23RD JULY, 1859, AND IN THE NEEBISH.

In June, 1863, a minute survey of the cut was made by assistant O. N. Chaffee, under the direction of Col. Graham, corps of engineers. From the profile of that survey I find the least depths of water, in three longitudinal profiles, one through the middle of the cut and one on either side, and 75 feet distant from the middle, to have been as follows, as we ascend: In left hand profile, least depth of water, 8 feet. In middle 10 feet. In right 7 feet. Between the two outer planes of these profiles, it is seen the water-

way is 150 feet wide; and it is straight through from deep water below the cut to deep water above, and the length is 5,200 feet. In this I find there was a reach of 500 feet where the twelve feet curves show the channel to have been contracted to less than 100 feet, and in which the least depth was $12\frac{1}{2}$ feet. In another place the 12 feet curves approach each other, showing a shoal of 11 feet of water over it, across the channel and 50 feet diameter. In another place the 12 feet curves approached to within 50 feet for an extent of 100 feet channelwise; and in the upper end of the cut, for an extent of 300 feet, the 12 feet curves approached within a distance of 50 feet towards each other.

In 1864, another minute survey of the middle channel-cut was made under the direction of Col. Raynolds, superintendent of the lake survey. From the longitudinal profiles (in the same positions as those of 1863,) of the last survey, I find the least depth as follows: In the left profile ascending, least depth of water 6.5 feet. In the middle 11.75 feet. In the right 9.00 feet. And in several places in the cut, I find the width between the 12 feet curves to be only 50, 60, 75 and 100 feet—showing encroachments upon the channel-way at bottom from washing in—nor do the least depths in the profiles remain in the same places of the respective profiles. Comparing the foregoing facts with those stated by Capt. Whipple in 1859, it is clearly proved that there occurred important changes between 1859 and 1863, also between 1863 and 1864, not only in the sides of the cut, but in the filling in, so as to materially diminish, not only the width of the water-way, but likewise the depth of the channel, which was, as Capt. Whipple reported in 1859, “nowhere in depth less than 14 feet for a width of 150 feet.” Probably the surface of the water, in 1863, was lower than in 1859, by .62 feet as was the case on St. Clair Flats. This correction, added to the least depths in the profiles of the survey in 1863, will make them show a filling in of 5.38, in the left, 3.38 in the middle, and 6.38 in the right, at places where Captain Whipple reported 14 feet of water at least, in 1859. We have no right to expect any-

thing like permanency in the bottom and sides of this cut, unless the sides are revetted with something better than the natural soft material left by the dredges, how well and often, soever, the dredging of this channel may be repeated.

Now, in regard to the west channel of the East Neebish rapids. Here it is not probable any material change has occurred since it was dredged, as the bottom is rocky. No surveys have been made since 1859 to test the question.

III. HOW MUCH SHALL BE DREDGED IN THE MIDDLE CHANNEL OF LAKE GEORGE?

Conceive two vertical planes 300 feet apart and equidistant from the middle profile, longitudinally through the cut; we shall then have five profiles in all, taking them correspondingly on either side equidistant from the middle one, and the planes of the profiles, taken in order, will be separated by a common distance of 75 feet. The extreme planes will include a water-way 300 feet wide, and 7,000 feet in extent from *b.* to *c.* (sketch A.)

The mean depths in the five profiles (survey of 1863,) will be:

In extreme left ascending, mean depth, 9.17 feet.

In next left at the middle, 10.53 feet.

In the middle profile, 13.28 feet.

In the right next to the middle, 11.59 feet.

In the extreme right, 8.38 feet.

The mean of the depths at *b.* and *c.* was 13.75 feet.

The annexed cross-section is constructed from the five mean profile depths just given, in which the scale of verticals is 10 times the scale of horizontals.

To dredge the cut according to this cross-section, would make the depth of water at the sides 13.5 feet, and at the middle 14 feet. The sides to be sloped 2 horizontals to 1 vertical. The width, on the bottom, 300 feet; and mean width, on top of under-water ground, 319.9 feet. The amount of dredging, according to his cross-section, would be 22,700,434 cubic yards.

But whether the cut should be of the above dimensions in cross-section as to width, is a question requiring more

careful consideration than has yet been given to it. It is seen that the cut has been filling considerably in some places in the interval between 1859 and 1863.

Below the cut, I find the channel, in its natural condition, holds a width of an average of about 200 feet in the lake between the 12 feet curves, for an extent of 5,000 feet, and is sufficiently straight and of ample depth for all purposes. In my estimation the natural width in this lower reach of the lake furnishes us with the true index to the width it is proper to attain by dredging for the middle channel, if we expect the force of the current to keep it clear.

The cross-section will explain the dimensions I would first dredge for this channel; the vertical scale is 10 times the horizontal.

The cut would be 200 feet wide at bottom, and 219.78 at top of the underwater banks, and the amount of the dredging would be 167,274 cubic yards. Of this, according to Captain Whipple, 7 per cent. would be hard and 93 per cent. soft material.

Therefore we should have:

Soft dredging, 155,565 cubic yards.

Hard dredging, 11,709 cubic yards.

Just below the lower end of the cut there is a bend on one side of the natural channel which Captain Whipple desired to straighten by dredging. This, I think, would be more a work of refinement than a necessity for the navigation; and as there are other places more needing to be dredged, I do not recommend at present any dredging on the said bend.

ESTIMATE OF COST.

7,000 feet channel extent—

Soft material, 155,565 cubic yards @ .75,	\$116,674.00
Hard material 11,709 cubic yards @ \$1.75,	20,490.00

\$137,164.00

If 5,000 feet on each side be revetted, \$171,700.00.

IV. HOW MUCH SHALL WE DREDGE IN THE WEST CHANNEL, EAST NEEBISH RAPIDS?

I think there ought to be made a straight channel following the upper course seen in red sketch "B." The dredging or excavation should be so directed as to deepen the water everywhere between the red line *a. b.* and the black channel line to 15 feet. There being no survey of this since Captain Whipple had the dredging done here, it is difficult to estimate the amount required, except to take his estimate 1,181 cubic yards, which will now cost \$20 per yard—\$23,620.00. I do not think that channel can be well improved at present prices short of this sum.

V. OTHER PLACES IN ST. MARY'S RIVER REQUIRING IMPROVEMENT.

Of these, besides the marking with buoys, of which there is much to be done, I learn, on consultation with the most experienced navigators of the river, there are several places much requiring improvement. Two are represented on sketch "C—" one at the head of Rains' Island, and the other at the foot of Sugar Island, where the sharp elbows are exceedingly difficult to turn in consequence of narrowness of channel and rocks. The mode of improvement is simple, consisting in dredging off the points of the underwater banks, so as to allow a channel in the direction of the red lines seen on the sketch. In the absence of minute surveys, I make the approximate estimate upon the general survey of 1857, and find 52,963 yards for Rains' Island elbow, and 55,703 yards for Sugar Island elbow.

Estimate of cost for total improvements indicated on sketch C, 108,666 cubic yards, @ .75, \$81,499.00.

Again; about $1\frac{1}{2}$ miles above the canal (see sketch "D,") there is a dangerous shoal of only 11 feet water, and the sunken rocks, close at hand although not shown on the chart, make an improvement here highly desirable; which, in the absence of minute surveys, I estimate at \$10,000.00.

VI. RECAPITULATION OF ESTIMATES OF PROBABLE COSTS.

1. Dredging Lake George middle channel \$137,164.00.
2. Revetting 5,000 feet on each side, - 171,700.00

-
- | | |
|--|-----------|
| 3. Dredging and probably blasting East Nee-
bish West channel, - - - - | 23,620.00 |
| 4. Dredging off underwater points at el-
bows at head of Rains' and foot of
Sugar Islands, - - - - | 81,499.00 |
| 5. Dredging and probable blasting at a place
1½ miles above St. Mary's Canal, - | 10,000.00 |
-

Total probable cost at present prices, - \$423,983.00

Here then, is what we shall need to bring the improvements of this important river to a permanent condition commensurate with the present and rapidly increasing Lake Superior commerce. And to expect at present prices to complete the improvements on a scale of good engineering for much less than this sum will be to count upon a vision. I recommend to commerce with the \$50,000 we now have, as soon as we can obtain, by advertising, reasonable bids for doing the work in the middle channel of Lake George; and, should Congress make the necessary appropriations, to follow the excavation of the work in the order in which I have stated the items.

B

*Report upon the Improvement of St. Mary's River, by
General T. J. Cram, Colonel of Engineers, U. S. A.,
for the Fiscal Year Ending 30th June, 1867.*

By acts of 23rd of June, 1866, and 2nd of March, 1867, the sums appropriated for this work amounted to \$100,000.

After fixing upon the plans for expending the money to the best advantage for the large and increasing commerce that is to be benefited by the improvement of this river, proposals were invited for dredging, Aug. 23, 1866, and a favorable contract was made for dredging, (only at present, however, in middle channel, Lake George, a shoal expansion of the river,) 5th of October, 1866. The work was to be commenced as soon as the machines could be taken there, and completed either by November, 1867, or

in the following season of 1868, according to the softness or hardness of material found necessary to excavate to obtain a channel not less than 200 feet wide at bottom, and of a uniform depth of fourteen feet below low stage at middle channel, and thirteen feet depth at sides, with side slopes of two horizontal to one vertical. It was not possible, owing to the lateness of the season before the contract was concluded and approved, to get the dredges safely into position before the 22nd of June, 1867. As soon as possible I sent my assistant, Captain Lydecker, corps of engineers, who fixed the range signals and established the low-water "bench-mark" to guide the dredges, and located the field for dumping. On the 29th of June dredging commenced in good earnest, and up to the 30th of June, 1867, there had been excavated 80 yards. From the 1st of July, 1867, onward, there are to be two dredges at work day and night.

Disbursed up to 30th June, 1867, end of fiscal year, on the work \$4.56, leaving available, 1st July, 1867, \$99,995.44.

I have seen no reason since sending in my annual report for fiscal year ending June 30th, 1866, to change the estimate I have made for the improvement of the several places requiring work to be done in this great river. Therefore, there will yet remain to be appropriated to complete the improvements, including per cent. for contingencies, \$323,983.

C

Report upon the Improvement of St. Mary's River, by General T. J. Cram, Colonel of Engineers, U. S. A., for the Fiscal Year Ending 30th June, 1868.

At the commencement of this year there was available for this work the sum of \$99,995.44, and the work during the year has been, under the contract, confined to dredging the middle channel, Lake George, and it has been the intention to complete this channel thoroughly to the standard fixed for the improvement before moving the machinery to

another place in the river.

From July 1 to November 8, 1867, the close of the season, one "Osgood" dredge worked on 21 days, and two worked on 87 days, for a greater or less number of hours in the day, which, according to my rule for keeping the dredging time, consists of 24 hours. To simplify the results, I reduce the total time for which the dredge actually worked to the number of hours one dredge would have worked continually to produce the same result that both did, and find the equivalent total number of hours' work for the one dredge to have been $2,468\frac{1}{2}$ hours, and the amount dredged, towed away and dumped for the same time, 109,724 cubic yards of soft clay, highly favorably for dredging.

The operations re-commenced 12th May, 1868, with one dredge, and continued with that until 17th June, when another was added to the force.

To 30th June, the end of the fiscal year, the results have been reduced as above to the equivalent performance of one dredge, as follows: Total number of hours, $555\frac{1}{2}$, and the amount dredged of the the same kind of soft clay, towed away and dumped for the same time, 28,691 cubic yards.

I now aggregate for the whole fiscal year, embracing all the days, except Sundays, on which it was practicable to work, and find the number of hours during which the work was being done 3,024, and the amount removed from the channel 138,415 cubic yards. The measurements were all made in the dumping scow. I could get no bids to measure otherwise, and the contract had to be made with this mode of measurement.

From the above figures we deduce the performance of the dredge to have been 45.78 cubic yards per hour.

The amount expended during the fiscal year for work and contingencies, to 30th of June, 1868, is \$67,942.87, distributed as follows:

To the contractor, including the 10 per centum retained until the completion of his contract, (this includes payment for 80 cubic yards dredging in June,

1867.....	\$66,477.60
To inspector of dredging, for services.....	807.00
Incidental expenses, laying out work.....	133.00
Purchase of boat for inspector's use.....	44.29
For the proportional part of office expenses chargeable to this work.....	430.98
Total.....	<hr/> \$67,942.87

All contingencies, including inspector's services, it will be seen from the above, are \$1,465.27. The contingencies, therefore, are only 2 2-10 per cent. of the whole expenditure.

The money available at the close of the year is \$32,-052.57.

From the report of my assistant, Captain G. J. Lydecker, corps of engineers, of the result of his recent inspection, there will be at least 80,000 cubic yards yet to be dredged before we shall have the channel completed. This, added to what has already been dredged under this contract, will swell to complete it to the probable amount of 218,526 cubic yards, which shows an excess of 51,252 cubic yards above what I estimated in my first report upon this channel, August 23, 1866. Whence this excess? That estimate of mine was made upon a survey made in 1864. In that first report it will be seen that I concluded, from the comparison therein drawn, that the unfinished channel left by Captain Whipple, corps of topographical engineers, in 1859, was filling up. This excess is partly due to this filling, since 1864, and partly to the mode of surveying the channel in 1864, which mode, however minute, was illy adapted to the problem of precise calculation of the amount to be dredged. Surveys for this purpose must be made in a more particular manner, or they are not worth much for the engineer of construction.

The money that we have available from the existing appropriations, 1st of July, will not complete this Lake George middle channel by about \$15,000. I trust this at least may be appropriated the present session of Congress, if no more, for St. Mary's River.

The amount requisite to be appropriated hereafter to

complete all the improvements contemplated in this river is \$398,983. This does not include anything for improving St. Mary's canal.

I think after all the improvements, exclusive of the canal, shall have been made, the annual amount thereafter required to keep the improvements in order will probably be \$10,000.

D

Report Upon the Improvement of St. Mary's River, by Brevet Major General Cram, Colonel of Engineers, U. S. A., for the Fiscal Year Ending June 30th, 1869.

During this fiscal year the work of improvement has been confined entirely to dredging in Lake George, middle channel, with a view of making it 200 feet wide at bottom throughout, and 14 feet deep in the middle and 13½ feet at the sides; and for this purpose the amount of clay and sand removed has been (from 1st of July, 1868, to 30th of June, 1869,) 76,342 cubic yards.

The amount expended and paid for this to the contractors, John Brown & Co., has been,	\$36,644.16
The amount paid and due for contingencies,	1,408.94

Total expended on the work this fiscal year,	\$38,053.10
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The progress of the work has been such that, at the end of this fiscal year, the channel, from its upper extremity for 5,050 feet, has been very nearly completed—leaving only some lumps and ridges, left by the dredge the first time going over, yet to be taken out; and the remainder of the channel, 2,170 feet, has been wrought generally to the full depth, but not as yet to the full width intended.

It is estimated that the amount measured in the natural bed, and yet to be taken out to bring this part to the full width contemplated, is 17,175 cubic yards, requiring about one month for two dredges, which are now engaged, to accomplish the task.

The amount available out of the specific appropriations

of 1866 and 1867, and out of the allotments from the general appropriations of 1868 and 1869, on the first of July, 1869, is \$14,799.47.

With this sum it is intended to complete, if possible, this important channel during the remainder of the season of 1869, and on its completion the present contract with Jno. Brown & Co., will be closed. The sum allotted out of the last appropriation will not, I fear, be sufficient to make the full width.

Other Places in this River Requiring Improvement.

These have been surveyed, and the plans and estimates made and reported during this fiscal year (see my report accompanying my letters to headquarters corps of engineers, 20th Jan'y 1862, also my more specific report upon the places, of date 30th June, 1869, accompanying this annual report.)

From the special surveys it is estimated that the improvements of the places other than the Lake George channel and the Sault St. Marie canal will cost as follows:

East Neebish, west channel, - - -	\$59,071.00
Channel at head of Rains' Island, - - -	56,380.00
Channel at foot of Sugar Island, - - -	19,570.00
Removing boulder rocks above the canal, -	3,000.00
Removing boulders in places below the canal, -	3,000.00

Total - - - - -	\$141,021.00
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The present commerce passing through this river justly demands the improvements.

St. Mary's Ship Canal,

This, it is well known, was built by the State of Michigan from the proceeds of public lands donated by the United States government for the purpose. Since it was built the commerce of Lake Superior has augmented so very much as now to require the capacity of the canal to be proportionately increased. With the view of its being improved by the United States government, the legislature of Michigan, in its last session, resolved by unanimous vote

to cede this important work to the United States; and thus it is obvious the first step has been taken in the right direction for its improvement.

This work cannot be made to answer the present and fast growing demands of the Lake Superior commerce, short of the following items of improvements:

1. Deepen the existing locks to a depth of 16 feet on the miter sill. There is now, in the low stage of navigation, only 10½ feet.

2. Deepen the canal to 17 feet, and render its sloping, rough, rocky sides vertical, and safe for vessels to pass through.

3. Construct a prolongation of the upper end of the north canal bank, to enable vessels coming down under a strong west wind to more safely enter the canal than they can at present.

4. Construct another lock, overcoming the fall with one lift, alongside the present two locks.

The expense of these improvements cannot be given until an examination and survey, which I respectfully recommend, shall be ordered by the proper authority and made for the purpose.

The cost of the necessary examination and survey, of the drawing of the plans and the making of the estimates, could be legally defrayed out of existing appropriations, and would be about \$1,200.

But this much in respect to the improvements I am prepared to say, viz: that all can be done without injury to the present lock walls, and without any destruction of existing works, except the old gates and miter sills, and some of the old grillage works, and that every item can be economically accomplished without interfering at all with the passage of vessels, by having everything and all materials ready in the summer, and taking advantage of the time to do the work between the closing and opening of the seasons of navigation.

The total amount required yet to be appropriated to complete the improvements contemplated in this river, besides for this canal, it has been stated, is \$141,021.00. The

amount required to be appropriated to economically carry on these improvements for the fiscal year ending June 30th, 1870, is \$60,000.

The amount for dredging, to keep all the improvements, when made, perpetually in good condition, including the Lake George channel, I think may be safely set down not to exceed, annually, \$10,000.

E

Report upon the Improvement of St. Mary's Falls Canal and River, by General O. M. Poe, Major of Engineers, U. S. A., for Fiscal Year Ending June 30th, 1870.

Under the act of Congress, approved July 11th, 1870, a project for the removal of boulders, above and below the canal, was submitted to and approved by the chief of engineers, and the contract for the work awarded to Messrs. W. W. and E. T. Williams, the lowest bidders, at the price of \$4,800 for the whole. They are now engaged upon it, and, under the provisions of their contract are required to complete the several improvements by the 1st of December, 1870.

Efforts were made to obtain the original drawings showing in detail the canal as actually executed, but without success. Finally making use of the best data at hand—that is to say, a lithograph published with the report of the directors of the canal company, dated September, 1858, and purporting to give a plan and section of the canal—a project was submitted to the chief of engineers for his approval, which it promptly received, so far as the general features were concerned.

This design aims at the enlargement of the water-way by cutting down the present side slopes and revetting with a stone wall wherever necessary; the new slope to be 3 inches to the foot, deepening the prism so as to give 14 feet of water upon the miter sills, removing the present guard gates, and rebuilding them in a new position, 700 feet

nearer the head of the canal, and establishing a new system of lockage on the south side of that now used.

Of the appropriation of the 11th of July, 1870, about \$140,000 will be available towards the execution of this design, and it is hoped this will be sufficient to bring the work of enlargement to a point below the new position chosen for the guard gates. The fact that the work now to be done must be performed in the winter season, under circumstances of great care, hardships and isolation, renders it very expensive. It is probable that the increased cost due to these causes, will amount to fully one-third of the whole appropriation now available. After this winter's work, the improvement may be prosecuted during the summer as well as winter, and the cost proportionally reduced. It is impossible, with the data at hand, to make even an approximate estimate of the total cost of the improvement; but it is safe to say that it will not be very much less than the original cost of the present canal, which was, I am told, about \$1,200,000.

Although less work is required to accomplish the contemplated enlargement and improvement, yet the higher prices of labor and materials now prevailing, will nearly or quite compensate. Hence, the sum of \$1,000,000, remains to be appropriated, of which amount \$500,000, can be advantageously used during the fiscal year ending June 30th, 1872.

This improvement should be prosecuted with the greatest vigor, as the present canal is taxed nearly to its full capacity; and, if any material increase of commerce grows out of the construction of the railroads leading from the head of Lake Superior westward, the canal must prove utterly inadequate to its accommodation.

I do not enter into any extended argument upon this point, as the facts are notorious. During this fall and coming winter, full and accurate surveys will be made, with a view to completion of plans and estimates in detail, in time for the next annual report.

In addition to the enlargement and improvement of the

canal, there are, as already reported by General Cram, (see page 106 of the report of the chief of engineers, for 1869,) other places in the water communication between lakes Huron and Superior, requiring improvement. The removal of boulders has been provided for; only the three first points enumerated by General Cram require immediate attention. These, together with the amounts required in each case, according to General Cram's estimate, which I assume to be correct, are as follows, viz:

East Neebish channel, - - - -	\$59,071.00
Channel at head of Rains' Island, - - -	56,380.00
Channel at foot of Sugar Island, - - -	19,570.00
Total - - - - -	<u>\$135,021.00</u>

In the foregoing, I have not included the item of \$20,000, for the Lake George channel, reported as necessary in my annual report. Therefore, the sums that will be required during the fiscal year ending June 30th, 1872, for the several improvements alluded to between lakes Huron and Superior, are as follows, viz:

For improvement of St. Mary's Falls canal, -	\$500,000.00
For improvement of St. Mary's River, -	155,021.00
Total - - - - -	<u>\$655,021.00</u>

And in order to prosecute the work advantageously the entire amount ought to be appropriated. Any material reduction will retard the work and increase its cost.

F

Report upon the Improvement of St. Mary's Falls Canal and St. Mary's River, by General O. M. Poe, Major of Engineers, U. S. A., for the Fiscal Year ending June 30th, 1871.

Though the subject of awarding the contract for the removal of boulders from the St. Mary's River, and of the submission and approval of a project for improving the canal,

was briefly referred to in my last annual report, dated October 14, 1870, I include herein, in order to make this report complete, a history of the improvements from the commencement of the fiscal year.

An Act of Congress, approved July 11, 1870, appropriated the sum of \$150,000 for the improvement of the St. Mary's Falls Canal and St. Mary's River, notice of which was received from the chief of Engineers under date of the 18th of July, 1870, with instructions to prepare and submit a project of operations thereunder. In partial compliance therewith I submitted a report, with form of advertisement inviting proposals for the removal of boulders endangering the navigation of the River St. Mary's and for improving the west channel of East Neebish Rapids, St. Mary's River, but subsequently receiving assurances that the object of the appropriation was to furnish the means of enlarging the prism of the canal *above* the locks, it was suggested to the Chief of Engineers, on the 11th of August, 1870, that if the case was so understood by him, to disapprove the project submitted; recommending, at the same time, that the work of making a prism of given dimensions and character, with a view to its connection with a new channel and locks along side those now in use, be let by contract in the usual manner.

Receiving instructions from the Chief of Engineers, directing that the project for operations upon the west channel of the East Neebish Rapids be deferred, and the advertisement for the removal of boulder rocks in the St. Mary's River be published as proposed, the publication of the advertisements was made accordingly, and the proposals offered opened on the 9th of September. The bid of W. W. & E. T. Williams, to do the work for \$4,800, being the lowest, was accepted and the contract awarded to them for the execution of the work. By the terms of the contract the contractors were to furnish all appliances and do all the work of removing obstructions in accordance with specifications—the work to be commenced on or before the 1st day of October, and completed on or before the 1st day of December, 1870.

No accurate surveys having been made at any of the localities specified, except at the point at the head of Rains' Island, it was found at some points that the work required to effect the desired improvements largely exceeded the amount anticipated.

The first four obstructions consisted of boulders and earth and were removed by dredging. The fifth was a ledge of limestone rock, lying in its natural bed, and was blasted and the pieces removed by a diver.

Operations by the contractors were commenced promptly at the three localities below the canal; and, on the 15th of October an inspection of the work, at the last two points specified, revealed the fact that the least water on the area dredged near the head of Rains' Island was $13\frac{1}{2}$ feet; and on the obstruction near the lower end of the island, 16 feet and 2 inches. Two days subsequently a further inspection of the work, two and one-fourth miles below the canal, showed a least depth of 16 feet, the water being in each case a few inches lower than in September.

These results being reported to me, I directed the resumption of the work at the point near the head of Rains' Island. This shoal was found to be of larger extent than had been supposed, and much more work was finally done than had been contemplated when the contract was executed. A further inspection of this locality was made November 23, (the dredge having been employed nearly two weeks after the receipt of my order directing the resumption of work,) resulting in the acceptance of the work.

The two localities designated above the canal were found to be projecting points of the same shoal, and of much larger extent than that supposed. The work at these points was inspected and accepted; the first on the 9th, and the last on the 27th of November, and the contract therefor completed and closed, and the balance due thereon paid to the contractors.

The amount of dredging required greatly exceeded all the estimates. The contractors performed more than double the work anticipated, and yet the entire navigation was but little improved; though what was accomplished was

directly toward that end. This was due to the fact that the obstructions did not consist of detached boulders as originally represented, and upon which a previous report and estimate were predicated, but of extensive shoals composed of boulders.

In accordance with instructions from the Chief of Engineers, a project was submitted to him on the 1st of September, 1870, with a view to the construction of new lockage alongside of that existing, and the excavation of the prism of the canal to a certain indicated width and depth. This was approved in general; but subsequently, modified specifications, with a report on the subject, were also submitted for approval, for so much of the new work as might be accomplished under the appropriation available, involving the enlargement of the prism, as well as the construction of a revetment wall and guard gates. This modified project was also approved; and, after due advertisement, a contract was entered into October 20, 1870, with Messrs. Barker & Williams & Bangs, the lowest bidders, for the prosecution of the work; the contract providing for the enlargement of the prism of the canal by excavation of the sides and bottom, so that, when the revetting walls should be built, the dimensions of the water-way, above the new position of the guard gates, would be as follows:

	FT.	IN.
Width at coping of revetting walls, -	102	6
Width at surface of water, 5 feet below coping, -	100	0
Width at 13 feet in depth, - - -	93	6
Width at 20 feet in depth, - - -	73	6
Depth of bottom along axis of canal, and for 36 feet 9 inches on each side thereof, measured from level of coping, - - -	20	6
Depth at 46 feet 9 inches on each side of the axis, measured from level of coping, -	18	0
Slope of sides after wall is built, or of excavation where it is in rock for 18 feet in depth below coping, 3 inches to 1 foot.		
Slope of sides from above named limit to bottom of canal, 60 inches to 1 foot.		

The contract also embraced the construction of a revetment wall and new guard gates, the latter upon the plan of the old ones, and to be placed in position at least 700 feet nearer the head of the canal.

The contract further provided that the contractors should receive as full compensation for the work performed, upon approximate monthly estimates, the following rates, viz:

For rock excavation, per cubic yard, \$3.50.

For gravel excavation, per cubic yard, .80.

For revetting wall, per cubic foot, .15.

For rebuilding guard-gates, \$15,000.

All measurements to be made *in situ*; and the work to be commenced on or before the 20th of October, 1870, and completed on or before the 1st day of July, 1871.

The plan of operations for the winter involved the removal of the guard gates to the new position, the deepening of the water-way, the removal of the side slopes, and the revetment of the sides of the cut with a wall of stone; the work to be commenced at the upper entrance to the canal, and continued downward, until the appropriation should be exhausted.

For nearly the whole distance from the inner end of the south pier to the guard gates, the rock appears above the water's surface, and from the inner end of the south-pier, westward, appears to have a slope to the westward of about 1 to 60. The rock is Potsdam sandstone, red and gray in alternating strata, and of very variable hardness—some so soft as to be removed easily with a pick and shovel.

The revetting wall was to be founded on the first stratum of suitable rock found in the sides of the excavation. Below the base of the wall, the face of the rock was to be dressed off to leave a smooth and uniform surface.

Contrary to expectation it was discovered that the excavation would furnish but little, if any, stone fit to use in constructing a revetting wall. It was believed that a sufficient quantity would be thus obtained to at least bring the walls to the surface of the water, and, owing to the lateness of the season, nothing else could have been relied upon.

Stone could not have been quarried at Sandusky or elsewhere and carried to the canal before the close of navigation.

Under these circumstances it was necessary to modify the previously adopted plan of operations, by postponing the removal of the guard gates and the construction of the revetment until another season, and to substitute for all of the revetment under water timber in the ordinary form of cribs instead of stone, as specified in the contract, provided the contractors were willing to put it in place complete at a price no greater in the aggregate than a stone wall of the same height would amount to at the contract price. This plan being approved, and the contractors assenting thereto, the specifications were modified accordingly.

The work of excavation was begun the latter part of October, the dredge operating on a shoal projecting into the channel past the outer end of the south pier. A force of laborers was employed removing the old slope-wall from the tow-path to the water's surface—commencing at the inner end of the piers at the head of the canal, working eastward, and ending at a point 600 feet above the guard gates. A dam was thrown across the canal at the inner end of the south pier, but it was impossible to make it perfectly water tight. A very considerable amount of water passed around the north end of the dam through a thin stratum of earth lying between strata of rock about 7 feet below the water line. Moreover, this dam happened to be placed over one of the places shattered some distance below the requisite depth, by blasting when the canal was built, and water found a passage through the crevices thus made in the rock beneath. Much difficulty was experienced in controlling the leakage, and on this account some delay attended the progress of the work. After the failure of repeated attempts on the part of the contractors to overcome this trouble, sufficient machinery for pumping was procured (some of it carried overland from Detroit,) and placed in operation, with slow but ultimately successful results. It consisted of a 12-inch Holly wrecking pump, two 6-inch lift pumps, one 4-inch lift and force-pump, and three centrifugal pumps, one with a 5-inch, one with a

6-inch and one with a 10-inch discharge-pipe. Of these, two of the centrifugal pumps proved the most efficient.

During December and a portion of January, however, when arrangements were being made and carried into effect for overcoming the leakage, the workmen were employed in removing the slopes from the water line nearly to the bottom of the canal; in the meantime the water, leaking through the dam and running down the canal, rapidly froze and soon covered the bottom with two feet of ice. By the 8th of January, the slopes had been removed to a point to which it was estimated the appropriation would cover the cost of the completed work.

Excavation above the dam was done by dredging. For 300 feet from the outer end of the south pier inward, the dredge completed the excavation, removing the rock with some difficulty; but east of this area the rock was generally too hard and the strata too heavy. An attempt was made in the early part of the winter by the contractors to loosen the rock for dredging by using a heavy chisel, weighing 4,000 pounds, fitted in leaders like the hammer of a pile-driver; but this proved unsuccessful.

The excavation below the canal was suspended on the 6th of May, and the removal of the dam commenced. Before the evening of the 8th an opening had been made sufficient to permit the passage of vessels. After the opening of navigation, the dredge was employed in completing the removal of the shoal beyond the outer end of the south pier, and in clearing up some small ridges of loose material over the area dredged between the piers. The entire amount of excavation to June 30, 1871, was, of rock 30,383.17 cubic yards; of gravel, 4,307.19 cubic yards.

During the fall and winter I caused a minute survey of the site of the canal and vicinity to be made, and a map of the same transmitted to me, by Mr. Alfred Noble, the assistant in the immediate charge of the improvement. A daily record of the height of the water's surface above and below the locks has been kept by my direction, and reported to me at the close of every month, in tabular form. A diagram in-

dicating the results obtained in this manner has been prepared, a tracing of which accompanies this report.

A table has also been prepared showing the mean elevation of the surface of the water, above and below the locks, above the datum plane of the survey of the canal referred to, (103.50 feet below the water-sill of the guard-gates) for each month, from November, 1870, to June, 1871, inclusive; and the mean elevation in each month during the prevalence of winds from each quarter of the compass. This table is also transmitted herewith.

It becoming evident that the first appropriation was not sufficient to keep the work going energetically all winter, an additional appropriation of \$100,000 was asked for, and made by Congress February 2, 1871. A plan for the expenditure of the same, if granted, had been submitted to the Chief of Engineers, January 28, 1871. It consisted of a proposition to continue the work of improving the prism, following the plan already approved, and to employ the same contractors at the rates named in their contract. This proposition was approved February 3, 1871, with the understanding that a new contract be entered into, and accordingly an agreement was made with Messrs. Barker & Williams, two of the contractors, for continuing the work at the same prices under the temporary appropriation referred to, Mr. Bangs withdrawing from the firm. The 1st of May, 1872, was fixed as the limit of the new contract.

By Act of Congress, approved March 3, 1871, the further sum of \$250,000 was appropriated for the improvement of the canal and river. It being deemed the most desirable to expend this amount in the construction of the new locks, plans and specifications were at once commenced, both for a system of two locks, each 80 feet by 400 feet, and a single lock, to overcome the difference of level at one lift,—the horizontal dimensions to be 80 feet by 400 feet. The work of preparing these plans has progressed ever since; but in view of the great amount of money involved in the work which they are to illustrate, much more time and careful study have been devoted to their preparation than would have been under ordinary circumstances. I feel that the

magnitude and importance of the work demand this care and deliberation, hence the plans are yet in an unfinished state. Authority was granted by the Chief of Engineers, April 22, 1871, to extend the contract with Messrs. Barker, Williams & Bangs, which expired July 1, 1871, to July 1, 1872. This extension was made because certain portions of the work could not be done before another winter, owing to the utter impossibility of procuring the requisite materials, due to no fault upon the part of the contractors, who as well as the agents of the United States, expected to obtain the materials from the excavation of the canal itself, but were disappointed. The deferred work, except obtaining and preparing the materials, can only be done when the water is out of the canal, and is, therefore, necessarily thrown into another season. The work thrown over is the revetment of the sides of the canal and the removal and rebuilding of the guard gates. The latter could easily have been removed from their present position, but could not have been rebuilt. I therefore directed that they should not be disturbed, since the safety of the locks, and indeed the entire canal, would surely have been imperilled thereby.

The approved plan for the enlargement of the prism and a new system of lockage requires land additional to the original grant, as well as the purchase of several lots at the lower end, now belonging to individuals. The latter are required to effect an entrance into the new locks, and must be acquired before any work upon them is done, since the excavation to be carried on with the greatest economy must be begun at the extreme lower end, and be carried thence into the lock-pit. Accordingly I wrote his Excellency, the Governor of Michigan, the following letter:

"Detroit, Michigan, January 27, 1871.

"SIR:

"I respectfully invite the attention of your Excellency to the necessity of taking steps to secure right of way for the improvement of the St. Mary's Falls Canal now in progress. Yesterday an additional appropriation of \$100,000 passed the United States Senate available for

"immediate expenditure. Should the House, as it doubtless
 "will, at once pass the same bill, and Congress follow this
 "with an appropriation of \$500,000 available after the 1st of
 "July next, the work can be pushed with great energy. But
 "nothing can be done beyond the limits of the present grant
 "without first acquiring the right of way, or rather the own-
 "ership in fee, of the land required. This is absolutely essen-
 "tial, and unless steps are taken at once, I greatly fear delay
 "from this source. The legislature of Michigan, now in
 "session, could readily pass any law, that may be required.
 "When the United States propose spending over a million of
 "dollars upon this improvement so important to the inter-
 "ests of Michigan, surely there can be no hesitation con-
 "cerning any legislation which may be necessary to give
 "full effect to the intention of the General Government. In
 "case any legislation is necessary I might refer to the pres-
 "ent laws of the State providing for the condemnation of
 "private property for light-house purposes, and cession of
 "jurisdiction over such property, as affording a convenient
 "basis upon which to frame laws to cover this special case.

"I am sir, with great respect,

"Your obedient servant,

"O. M. POE,

"Major of Engineers."

"His Excellency, H. P. Baldwin,
 "Governor of Michigan, president of Board of Control.
 To this communication the Governor replied as follows:

"State of Michigan, Executive Office, }
 "Lansing, February 2, 1871. }

"DEAR SIR:—

"I am in receipt of yours of January 27, relative
 "to the right of way for Sault St. Marie's canal. The
 "State holds 400 feet of land, for the whole length of the
 "canal. Will your improvement cover more than this
 "width? If not, I presume no action will be required.
 "Please advise.

"Very Respectfully Yours,

H. P. BADLWIN.

"General O. M. Poe, Detroit."

An act, drawn by the Attorney General of the state, was passed by the legislature, and duly approved by the governor. But this act only provides for the seizure of the required lands by the State of Michigan, and makes no provision for their transfer to the United States. Desiring to expedite the acquisition of the additional lands, I wrote the following letter:

Detroit, Michigan, May 12, 1871.

"SIR:—

"I have very respectfully to inquire what steps, "if any, are being taken to acquire title to the additional "land needed in the enlargement of the Saint Mary's Falls "canal. Also whether it is the intention of the Board of "Control to proceed further in the matter; and if not, the "present status of the negotiations, to the end that the "United States may act.

"Very Respectfully,

O. M. POE.

Major of Engineers, and Brev. Maj. Gen'l. U. S. A.

"His Excellency, H. P. BALDWIN.

"Governor of Michigan, and president, Board of Control, Detroit.

And the next day received the following reply, from which it is seen that action is postponed until after the 30th of June, the date upon which this report closes. The subsequent action of this matter will be made the subject of a special report.

State of Michigan, Executive Office, }
May 13, 1871. }

"DEAR SIR:—

"In reply to yours of May 12, I have to state that "the legislature at its recent session passed an act author- "izing the governor to appoint a commission of three per- "sons to condemn such lands as may be needed for the "enlargement of the St. Mary's Falls Ship Canal. Before "this can be done it will be necessary that I receive official

"notice that lands are required for that purpose, accompanied with a plat and description of the lands wanted. "On receiving such notice and plat, action will be taken.

"I am expecting to be absent for a few weeks, and early "in July to visit the canal, at which time the commission "can be appointed if so desired.

"Very Respectfully,
H. P. BALDWIN.

"General O. M. Poe, Detroit."

Under date of 16th of June, I called the attention of the contractors to the fact that no sufficient examinations had been made for the purpose of determining the extent and character of the coffer-dams, which they propose to use for next winter's work, and that it would probably be necessary to cut a channel at least on the back of the north pier, to be filled with water-tight material, in which case the work should be taken in hand at once, and that the clay and other material required for this dam should also be obtained, and put upon the ground at as early a day as practicable, to the end that no delay might take place in getting the dam in; that in fact a considerable portion of the dam might be put in before the close of navigation.

Their attention is also invited at the same time to the necessity of having upon the spot when needed the timber required for rebuilding the revetment. Acting upon these suggestions, the work of delivering the stone and timber was taken in hand without delay, and is now in progress. Operations during July and August have consisted entirely in the delivery of this material.

The following shows the present financial condition of the improvement:

Amount available July 1, 1870, \$———

AMOUNTS UNDER CONTRACT.

Amount appropriated July 11, 1870,	-	\$150,000.00
Amount appropriated February 2, 1871,	-	100,000.00
Total	- - - - -	\$250,000.00

Amount expended from July 1, 1870, to July 1, 1871. - - - - -	108,318.41
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Balance (all of which is under contract) -	\$141,681.59
Amount appropriated March 3, 1871, but not yet under contract, - - -	250,000.00

Amount available July 1, 1871, -, -	\$391,681.59
Amount required for the fiscal year, end- ing June 30, 1873, - - -	\$884,977.08

The balance of \$141,681.59 on hand at the beginning of the present fiscal year, includes \$10,978.67, being aggregate amount of percentage retained from payment made to contractors from time to time, in accordance with the terms of their contract, and the materials already delivered (timber for revetment and stone for guard-gate walls) cover some portion of this balance, but are not to be paid for until placed in the work.

No attempt is made to give statistics concerning the importance of this work, as it is so well known. Suffice it to say that nothing can pass, by water, between Lake Superior and the lower lakes, without passing through this canal. The commerce interested is the entire traffic by vessels between Lake Superior and other lakes, and, large as it now is, will, as the Northern Pacific and other railroads having a terminus upon Lake Superior are extended, rapidly and greatly increase.

In naming an amount to be appropriated at the next session of congress, I am guided by the estimated cost of the new system of lockage, which is \$884,977.08. It is of importance that this entire amount should be appropriated in one item, in order to put the work under one contract. To appropriate it by piecemeal may throw the work into the hands of different contractors, thus securing the most work at the maximum of cost. The appropriation of the whole amount at one time will greatly reduce all incidental expenses, and reduce the time before completion to a minimum.

I feel as though I could not press this matter too earnest-

ly; and I further desire to say, that I have, in the estimate, left no margin for reduction; even if only \$50,000 be taken off, I doubt whether enough would be left to accomplish the object. All of which is respectfully submitted.

EXHIBIT A.

Statement of the number of vessels and their tonnage passing through the St. Mary's Falls Ship Canal each year, from 1865 to 1870 inclusive, and four and a half months of 1871:

YEAR.	No. of Passages.	Tonnage.
1865.....	997	409,062
1866.....	1,008	458,530
1867.....	1,305	536,898
1868*.....	1,115	432,463
1869.....	1,336	526,323
1870*.....	1,883	696,855
1871, $\frac{1}{2}$ of June.....	1,311	576,773

*In June of this year three out of the four shipping docks at Marquette were destroyed by fire, cutting off the facilities for shipping ore, and damaging seriously the business of that year.

†The increase over the year previous is about 33½ per cent.

EXHIBIT B.

Statement of the product of the iron and copper mines of Lake Superior for each year during a period of ten years, from 1861 to 1870 inclusive.

YEAR.	IRON.			COPPER.	
	Iron Ore, Gross Tons.	Pig Iron, Gross Tons.	Value.	Ingot Copper, Tons.	Value.
1861.....	45,430	7,970	\$ 419,401	7,500	\$3,397,500
1862.....	115,721	8,590	984,977	6,300	3,402,000
1863.....	185,257	9,813	1,416,865	6,500	4,420,000
1864.....	235,123	13,832	1,867,215	6,500	6,110,000
1865.....	*196,256	12,283	1,580,430	7,000	5,145,000
1866.....	296,972	18,436	2,405,960	7,000	4,760,000
1867.....	466,076	30,911	3,475,820	8,200	4,440,000
1868.....	507,813	38,246	3,982,413	9,985	4,592,000
1869.....	643,290	40,000	5,296,318	12,200	5,398,000
1870.....	856,471	50,000	6,266,769	12,581	5,567,600

*Year of the close of the war.

The average annual rate of increase of the iron business for ten years is 45 per cent. The rate of increase for 1870 over 1869 is 33½ per cent. Estimated product of 1871 1,000,000 tons.

Table showing the aggregate tonnage of vessels and steamers passing St. Mary's Falls canal, for each month from May to September, in 1870, and 1871.

MONTH.	Tonnage, 1870.	Tonnage, 1871.
May	113,241.5	77,735.78
Jun e.....	116,566.5	123,565.49
Jul y.....	121,362.5	154,923.85
Aug ust.....	106,662.3	115,066.93
September.....	96,529.0	103,490.40
Total.....	534,361.8	574,772.45

The increase for 1871, is 20,410.65 tons. There is, however, a decrease in the number of vessels; the number locked through in 1870, up to October 12, being 1,580, against 1,366 for the present year. This comparison shows that the vessels now passing are of a larger class than those heretofore in use for this trade.

G

Report upon the Improvement of St. Mary's River and Ship Canal, by General O. M. Poe, Major of Engineers, U. S. A., for Fiscal Year Ending June 30, 1872.

Since the close of the last fiscal year, further action has been taken for the acquirement of the additional lands necessary for the enlargement of the canal; and, to render the subject complete, a detailed history of this action is given, as follows:

The Governor of Michigan, under date of Aug. 12, 1871, was requested to furnish information concerning the progress made in acquiring title to the lands referred to, and, under date of Aug. 15th, he furnished the information called for. He stated that efforts were made by the Board of Control, in 1870, for the purchase of such lands as they deemed likely to be wanted for canal purposes. These being unsuccessful, renewed efforts had been made during the season of 1871, but also without success. He further stated that the legislature of 1871 authorized the Governor to appoint a commission to determine the value and condemn the lands which might be required, but that doubts having arisen as to the constitutionality of some of the im-

portant provisions of the act, it was submitted to some of the most able and reliable lawyers, the result of which was to lead him to defer action for condemning the lands until the act could be amended in some of its features, which could probably be accomplished during the following winter. That, in the meantime, all proper efforts would be continued for the purchase of the lands.

The amendment of the act referred to, however, was never effected by the legislature, for the reason, as I understand, that the act in question was unconstitutional, and that the legislature had no power to so amend it as to provide for vesting title in the United States to the lands required in the manner indicated.

This, therefore, terminated all efforts in that direction to accomplish the desired result.

Under date of Aug. 22, 1871, I transmitted to the chief of engineers a tracing of a plat showing the government land on the south side of the state canal grant, with subdivisions and names of claimants; also a tracing on a smaller scale, showing the relation of these claims to the canal enlargement, as well as the history of each claim so far as I have been able to obtain it. The location of this land is in section 6, township 47 north, range 1 east, being a portion of a tract granted to the Indians as a reservation, and subsequently yielded by them to the United States. A complete history of these transfers could not be given. A clause in the treaty with the Ottawa and Chippewa Indians, dated July 31, 1855, indicates that the right of fishing and encampment, (on lands presumed to include those shown on the tracing,) was secured to the Chippewas of Sault Ste Marie, by the treaty of June 16, 1820. Reference to this, made in article 3 of the treaty first mentioned, indicates that the right was not yielded by the Indians at that time; but I was informed that it was yielded soon after by a special treaty with the band at Sault St. Marie, by which the United States assumed entire control of the whole tract at the rapids, except a small island in the river. The right of way through this tract was granted by the United

States to the State of Michigan for the purpose of making a canal, the grant including an area 200 feet in width on each side of the center line of the canal, a total width of 400 feet.

Soon after the settlement of the Indian claims (in 1855 or 1856) different parties "squatted" upon various portions of the land on the south side of the "canal grant," either building and living upon their claims, or fencing and cultivating them. The claims referred to are six in number. No taxes were ever paid on any of this land. Having been considered government land, it was never assessed. I recommended the retention of all the lots except the one claimed by Carleton and Bernier, and submitted for instructions the question of entering on the lands and dispossessing the claimants. The above being submitted to the Judge Advocate General for his opinion as to the authority of the United States to take possession of the land claimed by squatters, he expressed the opinion that, if thought proper, they might be legally dispossessed, and gave the course usually pursued in such cases. The Secretary of War, therefore, requested the Attorney General to call upon the proper United States marshal to eject all the squatters.

The Deputy United States marshal was at the canal during the latter week of September, 1871, for the purpose indicated, and arranged the matter so that the occupants were to vacate their claims whenever called upon to do so. He transferred his authority in the premises to Mr. A. P. Heichhold, who was to act whenever called upon. The lands belonging to individuals, and also required in the enlargement, were made the subject of a separate report to the Chief of Engineers, on the 22nd of August, 1871. This report contained a history of the progress made in acquiring title from its inception to the date of the report, and showed that the attempts made were failures, as appears by letter before referred to, from the governor of Michigan. It also contained a request for instructions as to the application or expenditure of the \$250,000 appropriated March 3, 1871; whether the same should be retained entire until a

further appropriation be made, and then the whole applied to the construction of new locks, or whether so much of it as could be expended in enlarging the prism during the winter be devoted to such purpose; and, if the latter should be deemed best, that it would be necessary to make a new contract, and the question was presented whether it should be done after advertising or by arrangements with the contractors at the prices of their existing contract. This latter was recommended, in view of the great annoyance, and possible detriment to the work which would arise from having two sets of contractors at the same time, engaged upon the same work, and at different rates.

It was decided, however, by the Chief of Engineers, in a communication dated August 26, 1871, that the appropriation referred to should be applied as soon as practicable, to the construction of the prism of the canal, but that proposals for such additional work should be invited in the usual manner.

The Chief of Engineers, under date of October 2, 1871, requested an estimate of the probable amount required to reimburse the State of Michigan for sums expended in acquiring land from private individuals, for modification of the canal, or for acquisition of the land by the United States, under a condemnation act. In reply to request of October 4, 1871, for such information, the Governor of Michigan, in a letter dated Dec. 1, informed me the aggregate amount asked for the additional lands was \$14,000.

This information was communicated to the Chief of Engineers on the following day, with the statement that, to acquire the lands, we were driven to one of three measures:

- 1st. To purchase the land from the owners at any price they might see proper to ask.

- 2d. The enactment by Congress of a law conferring upon the proper authorities of the United States the right and power to seize and condemn the land needed; or,

- 3d. The enactment by Congress of a law authorizing the expenditure of a portion of the appropriation upon lands

belonging to the State of Michigan, in which case the State could seize the lands, condemn them, and acquire title.

Of these three, the second was strongly recommended.

The act of Congress, approved June 10th, 1872, appropriated \$300,000 for the work, with a proviso that \$15,000 of that sum might be expended in securing the desired right of way over the grounds belonging to private parties at the east end of the canal. Upon being informed of this, I at once took measures to ascertain the price at which each individual owner was willing to sell the portions of the lots required. Proposals have been received accordingly, and indicate that the owners adhere to the prices previously named to the State authorities, which in the aggregate reach the sum of \$14,000. This sum is largely in excess of the real value of the property, but it is not at all likely that the demands of the owners will ever be diminished.

Upon the basis that only the immediate water-fronts of all the claims be purchased in addition to the amount of claim seventy-eight, originally proposed, offers from the owners were also obtained, the total amount of which is \$7,050.

These two propositions were submitted to the Chief of Engineers on the 22nd of July, 1872, with request for authority to accept one of them, and with the remark that I considered the first one unobjectionable and desirable; but that the second was subject to the objection that it would leave the owners all their right and title up to the channel bank as it would be after the dredging proposed to be done, in which case they might permit vessels to obstruct the entrance to the new lock, though I thought it would subserve all necessary purposes.

The titles being considerably involved, I, at the same time requested that application be made to the Attorney General of the United States to instruct the District Attorney to have the title papers put into proper shape.

Under date of July 30, the Chief of Engineers instructed me to enter into negotiations for the purchase of the additional lands with the persons named in the first proposition

referred to, and stated that application would be made for instructions to the United States Attorney for Michigan to assist me in preparing the title papers, and in such other duties connected with the purchase as might seem necessary.

The District Attorney having received the requisite instructions in the premises, the matter is now in his hands; and it is hoped that the preparation of the transfer papers will be pushed forward as rapidly as possible.

As authorized, an advertisement was published inviting proposals for continuing the enlargement of the canal and building a revetment of timber and ballast stone, under the appropriation of \$250,000, approved March 3d, 1871.

The proposals were opened on the 10th of October, and were as follows:

*Abstract of Bids for Continuing the Improvement of St. Mary's Falls Canal, Opened at 3 P. M.,
October 10, 1871, in Accordance with Advertisement, Dated Sept. 7, 1871.*

BIDDERS NAME AND RESIDENCE.	EXCAVATION.							REMARKS.
	For rocks per cubic yard.	For gravel per cubic yard.	Timber per cubic foot.	Pine plank per 1,000 b. m.	Iron bolts per pound.	Spikes per pound.	Framing, putting in place, etc., per cubic feet of timber.	
Alanson Dodge.....	3.50	1.00	0.30	\$40	0.10	10	0.10	{ Nov. 10, 1871. { Aug. 1, 1872.
Jas. F. Hayden, Samuel W. Norton.....	3.87	1.08	.58½	24.95	.5½	6½	.17	{ Nov. 15, 1871. { Nov. 1, 1873.
Chas. J. De Graw, Fulton, N. Y.....	3.80	1	.40	75	.12	12	.15	{ Sept. 1, 1873. { Nov. 25, 1871.
Sam'l G. Hart, Fulton, N. Y.....	4.50	2.50	.30	40	.7	7	.40	{ July 1, 1872. { Dec. 15, 1871.
C. C. Barker, Fayetteville, N. Y.....	.....	.....	.....	.....	.....	.....	.....	{ May 15, 1872. { Oct. 16, 1871.
Wallace W. Williams Manlius, N. Y.....	3.00	.60	.20	25	.5	7	.10	Sept. 1, 1872.
O. J. Jennings, Syracuse, N. Y.....	3.75	1.50	.28	50	.7	7	.28	{ Dec. 1, 1871. { June 1, 1872.
C. C. Barker, Fayetteville, N. Y.....	.....	.....	.....	.....	.....	.....	.....	{ Oct. 16, 1871. { July 1, 1873.
Wallace W. Williams, Manlius, N. Y.....	2.40	.70	.20	25	.5	7	.10	

On the following day the abstract was transmitted to the Chief of Engineers, showing that the bids of Barker & Williams (one for the completion of the contract by September, 1872, and the other for the completion of the contract by July 1, 1873,) based upon approximate estimates of quantities, were each lower than the offer of any other bidder, and the second considerably lower than the first.

The Chief of Engineers, Oct. 27, 1871, authorized the acceptance of the second proposal referred to; *i. e.*, for the completion of the contract by July 1, 1873, and the articles of agreement were entered into accordingly.

The Governor of Michigan, president of the State Board of Control, under date of August 30, 1871, gave notice that for the purpose of repair and improvement, the canal would be closed at 12, m., on the 25th of November, 1871, to remain closed until the 1st day of May, 1872. February 20, 1872, I informed the Governor that the first order of the Board of Control fixed the dates as above stated, and that subsequently the date of closing was fixed at the 1st of December, but the date of opening was not changed; that the result of this extension of seven days the previous fall was exactly what was feared; namely, the hard freezing weather came on, and owing to the low temperature, the contractors were seriously interfered with.

In view of this fact, I stated that it seemed but simple justice to the contractors to fix the 20th of May as the date of opening; but as the commerce of Lake Superior would be seriously incommoded by such an extension, I suggested instead thereof, as a partial reparation, that the 10th of May be named as the day of opening. This date was, therefore, specified.

An application having been received from the contractors for the extension of their contracts of October 20, 1870, and Feb. 9, 1871, to the 1st of July, 1873, it was forwarded to the Chief of Engineers Feb. 24, 1872, with a statement of the condition of the work and the reasons leading to a recommendation that the extension asked for be granted. The extension was granted, but with the understanding

that the contractors furnish additional security for the performance of the work, and that the clause contained in the new form of contracts, and embraced in their contract of December 7, 1871, in relation to failure to commence and prosecute the work faithfully, etc., be inserted in the contracts; that should the contractors decline to accede to these terms, and the contracts should at the periods specified for their completion, viz., May 1, 1872, and July 1, 1872, (the contract of October 20, 1870, having been extended for the latter period,) be unfulfilled, to declare the retained percentage forfeited to the United States, and proceed to execute the work by hiring labor and purchasing materials in open market, unless it would be more advantageous to re-advertise for proposals. The contracts were extended to July 1, 1873, as authorized, and the additional articles of agreement, with the required bonds, were executed on the 15th day of April, 1872. Immediately upon the receipt of the authority granting this extension, I directed that the work upon the new guard gates be prosecuted with the greatest vigor; that they must be rebuilt in the new position, and that the construction of the outer dam (at section 30, west) would be dispensed with for the winter.

On the 18th of June, last, I reported that Barker, Williams & Bangs had performed their contract under the appropriation approved July 11, 1870, and that the retained percentage had been paid them and the contract closed, and that the guard-lock had been rebuilt, removed and paid for.

Seeing that no efficient steps had been taken to put in so much of the coffer-dam required for the work of next winter as is comprised in the wings and through the piers to the channel on each side of the canal, I reminded the contractors, under date of June 19, 1872, of their failure in this respect last year, and gave them warning that any omission would not be again overlooked under *any* circumstances, and expressed a desire that they would take the matter in hand within thirty days and prosecute to completion the work of putting in the wings of the coffer dam on both sides

of the canal, extending each wing from the natural shore along the back sides of each pier to the proper point on each, and then through the channel.

The progress of the work during the year was very slow, delays arising at almost every stage. Some of this was due to the fault of the contractors, though they operated at times under the most trying difficulties. The extreme severity of the winter, when the most important work only could be carried on, retarded the progress of the work and placed the contractors in an embarrassing condition. The difficulty in keeping the force employed up to the requisite standard for the vigorous prosecution of the work added to the causes of delay; yet it is believed that this difficulty could have been ameliorated to a certain extent by the contractors by a judicious line of action in the employment and payment of the men. The isolated region, however, to which many men are reluctant to go, furnishes some excuse for the low standard of the force during the year.

Operations during July, August and September, 1871, consisted only in receiving timber to be used in the revetment. The bills of timber furnished the contractors embraced 113,000 cubic feet, which they sub-let to parties on the river and on the shore of Lake Huron. Only about one-third the amount called for was furnished, hardly sufficient to build the revetment to the water line.

In October the contractors organized a small force and employed it clearing the site of the pier, above the water line, extending this work eastward to the guard gates on the south side and to the basin on the north side. A part of the force was detached in November and set at loading and hauling clay for the dam. The cold weather set in very early (about November 25) freezing the clay that had been deposited on the bank of the canal into a solid mass, rendering it useless.

The canal being closed to navigation December 1, the frame of the dam was placed in position at once. It had been the design of the contractors to place the dam at section 30 west. Some dredging was necessary before doing

so, to break through the piers and clear the sites for wing dams connecting the main dam with the shore line. They failed to get the dredge at work in time to do this before December 1, and concluded to place the dam at the river end of the south pier, at the position occupied for the same purpose the previous year.

It was understood that this dam would be only temporary, and that the one at section 30 would be put in immediately after. The contractors did not have sufficient force on the work during the winter to render it possible to fulfill this promise without neglecting other work of greater urgency.

The clay for filling was hauled from the pit, about three-fourths of a mile and used at once; but, the weather was so severely cold that the clay froze on the way, and was rendered very unsuitable.

The entire month of December was consumed in repairing the dam after successive leaks. Besides the leaks through the dam itself, the water passed through crevices around the rocks at the ends and under the bottom in the same manner, and in about the same quantity as during the previous winter. This had to be removed by pumping. The pumps were set up, and a pump house built early in January.

The excavation during the winter was from section 14 westward to section 5, completed; and, from section 50 eastward to section 74, left uncompleted.

The guard gates and walls were removed during March and April, and placed in a new position 700 feet above the old one. The revetment was carried above the ordinary water-line between the guard gates and the dam, and to within about 4 feet of the water-line, between the guard gates and section 71. Upon commencing the removal of the dam, May 7, it was found that the top of the dam, for a depth of 2 feet below the water-line, or about 4 feet below the top of the dam, was a solid mass of frozen earth, through which the dredge of small power and in bad repair could make but little headway. A practicable opening for the passage of vessels and steamers was made late on the

11th, (a day later than that fixed for the opening of the canal,) and on the morning of the 12th all those in waiting passed through.

Since the opening of navigation a small force has been employed in gravel excavation below section 77.

About 5000 feet of cubic feet of timber have been received.

The operations during the year to June 30th, inclusive, resulted in the excavation of 17,741.16 cubic yards of rock, and 26,839.40 cubic yards of gravel. In addition 57,681.11 cubic feet of revetment, estimated as revetting wall, was placed in the work, and the guard gates rebuilt. A table giving the mean water stage during each month, and showing the effect of certain winds, and a tracing of a diagram showing the elevation of the water's surface during each day in the year, are transmitted herewith. I also accompany this report with a tracing of a map of the canal, with proposed improvements, which shows the condition of the work at the close of this year.

Under date of June 18, 1872, I was notified that \$300,000 had been appropriated by act of Congress, approved June 10, 1872, and requested to submit a project of operations thereunder.

Except that portion of it provided for the purchase of the additional lands required in the enlargement of the canal, it is proposed to expend this sum toward the construction of the new locks, the plans for which are nearly completed.

The project called for is necessarily delayed pending negotiations for the acquirement of the land, but will be taken in hand as soon as possible and submitted for the action of the Chief of Engineers.

The following shows the financial condition of the improvement at the close of this year, and the amount recommended for the service of the fiscal year ending June 30, 1874:

Amount available July 1, 1871, and under	
contract,	\$381,681.59
Amount expended from July 1, 1871, to	
July 1, 1872,	99,469.36

Balance on hand July 1, 1872, - - -	292,212.23
Amount appropriated June 10, 1872, not yet under contract, - - - -	300,000.00
	<hr/>
Amount available July 1, 1872, - -	\$592,212.23
	<hr/>
Amount required for fiscal year ending June 30, 1874, - - - - -	\$600,000.00

The balance of \$292,212.23 on hand July 1, 1872, includes \$6,671.86, being aggregate amount of per centage retained from payments made to the contractors from time to time, agreeably to the terms of their contract. The materials already delivered under existing contracts, but not placed in the works, also cover some portion of this balance.

The extent of commerce involved in this improvement is so well known that no statistics of the same are deemed necessary. It embraces the entire traffic by vessels between Lake Superior and the other lakes, and its magnitude has already attained proportions of a larger character with a rapid and greatly increasing tendency.

The estimated cost of the new lock is \$884,977.08. Of this amount the sum of \$285,000 has been appropriated (\$15,000 of the last appropriation having been made applicable to the purchase of the additional land required in the enlargement) leaving in round numbers, the sum of \$600,000 yet to be appropriated. The construction of the new lock will require more than one year's time, but the great advantage to the government arising from the letting of the contract for the entire construction, at one time, induces me strongly to recommend the appropriation of the entire sum at once, and my estimate of the sum required for the fiscal year 1873-'74 is based upon this.

H

*Report upon the Improvement of St. Mary's Falls Canal,
by General G. Weitzel, Major of Engineers, U. S. A.,
for Fiscal Year Ending June 30, 1873.*

This work was in charge of Maj. O. M. Poe, Corps of Engineers, until May 1, 1873, when I relieved him.

Since the close of the last fiscal year further action has been taken relative to the purchase of parts of private claims Nos. 68, 75, 76, 77 and 78, required for the canal improvement, as follows:

The purchase of the required portion of claim No. 68 has been undertaken by the State Board of Control. There appears at present no reason why it should not be completed at an early day.

In September last, Mr. H. H. Swan, assistant United States district attorney, arrived here with authority to negotiate for the purchase of these claims. The purchase of claim No. 68 seeming then (as for a long time previously) to be nearly perfected, he took no action in regard to it. He procured deeds to the required parts of claims Nos. 75, 76, 77 and 78, from parties residing here, which were transmitted, with copies of other papers found on the county records, to the Attorney General of the United States. After examination of the papers transmitted, the Attorney General decided that the deeds gave valid titles to the parts of claims 75, 77 and 78 required, while those relating to claim 76 were deemed insufficient. The title-papers relating to claims 75, 77, and 78 were placed on record in the office of the register of deeds of Chippewa county, after which payment was made. The title to the required part of claim 76 has not been obtained, and remains for further action.

Operations from July to November consisted of excavation between sections 72 and 131, the partial excavation of a ditch from section 131 to section 226, and building revetment from section 02 to section 129. The excavation between sections 72 and 131 was in the enlargement, the old tow-path having been left in place to separate the pit from the canal. The pumps were at section 131, and were run continuously. The work was delayed two or three times by breaks through the bank from the old canal, these breaks being through the rock, and not through the overlying earth.

The date for closing the canal was fixed by the Board of Control at December 1, and afterward postponed until December 3. Navigation was closed very suddenly November 27, by one of the severest storms known for many years. During the storm the canal became filled with ice driven in to a great depth; this, and the cold weather immediately following, rendered it impossible for steamers to force a way through the canal. During and immediately after the storm the upper end of the canal, from section 15 west, westward, was filled with steamers and vessels seeking refuge and quarters for the winter.

The contractors had been preparing to place a dam at section 30 west, in order to excavate about 11,000 yards of rock and a small quantity of gravel, between that section and the guard-gates. As the site of the proposed dam was occupied by steamers it was impossible to build it, and that work was given up for the season.

The guard-gates had been closed November 27, soon after the storm commenced. Three pieces of canvas were placed successively on the upper side, reaching from the water-line to the bottom, with a flap of from 2 to 6 feet resting on the bottom, and from wall to wall. These stopped the leakage about the valves entirely, and reduced that at the miter-sill so much that it was easily kept from the work during the winter.

The excavation during the winter was between sections 71 and 119.

At the opening of navigation the revetment had been built to the ordinary water line from the guard-gates eastward to section 71 on the north side, and to section 128 on the south side.

Work at excavation was suspended May 3, the guard-gates opened May 4, and the canal in readiness for the passage of vessels May 5, the day fixed by the Board of Control.

In order to place that part of the appropriation of \$300,000 which was made by the act approved June 10, 1872, not set apart for the purchase of lands under contract, proposals were advertised for under date of March 26, 1873, for excavating the lock-pit and putting in place the foundation.

Bids were opened on the 30th of April following. There were only two bidders. The abstract (marked A) of these bids is annexed hereto. The contract was awarded to the lowest bidders, Messrs. Boyle & Roach, and they commenced work on the 28th of May following, and have made good progress.

The \$200,000 appropriated for this work by the act approved March 3, 1873, has not yet been placed under contract, but will be as soon as some further information concerning stone for the lock-walls and iron for the pipes can be obtained. This will be in a short time.

The whole sum will be devoted to beginning the construction of the new lock-walls; and to enable me to carry them on with uniformity and the greatest economy, an appropriation sufficiently large to complete them should be made. In addition, the importance of the work merits the largest appropriation possible.

The commerce passing this point is already enormous, and is steadily increasing. During this season alone one and one-half million tons of iron ore will pass here. This ore is mainly taken to Cleveland and Erie, and thence distributed. The iron into which this ore enters is distributed all over the country, and thus makes this work in every sense of the word a national work.

The aggregate tonnage which passed through here last year was 918,600 tons.

The amount expended during the year was \$158,121.49

The amount available July 1, 1873, and under contract, is - - - - - 423,112.07

The amount available July 1, 1873, which will soon be under contract, is - - - 200,000.00

The amount required for the fiscal year ending June 30, 1875, is - - - - - 500,000.00

A great deal more work will be done this year than it has been possible ever before to do, especially if the Board of Control of the canal keep their promise and close it in time to enable the contractors to build the dam and thus finish the excavation. I am confident that all of the money now avail-

able will be expended before the beginning of the fiscal year 1874-'75. The new appropriation should, therefore, be large enough to enable me to place all that remains to be done at the locks under contract at once.

I

Report upon the Improvement of St. Mary's Falls Canal and River, by General G. Weitzel, Major of Engineers, U. S. A., for Fiscal Year ending June 30, 1874.

I—SAINT MARY'S FALLS CANAL.

Since my last annual report the part of claim No. 68 which was required for the canal enlargement has been purchased by the State Board of Control, and the title papers to claim No. 76 were perfected and placed on record in the office of the Register of Deeds for Chippewa county. It was paid for last February. The title papers to all the land required are, therefore, now held by the government, except to claim 68, which is held by the State Board of Control.

During the past year the greatest amount of work was accomplished that has been done in one year since the commencement of the improvement. The winter was very favorable for work, and the contractors took advantage of it.

The canal was closed to navigation on the 19th of November, 1873, by placing a dam across its bed near section 30 west, connected through openings in the piers by wing-dams with the shore-lines. Leaks through the north wing and the north bank of the canal near section 9 west, which were not stopped until December 10, delayed the work considerably. After this a steam pump, started near section 18 west, and the one stationed at section 131, easily kept the pit free of water. The excavation of the old channel between section 27 west and section 142 east was almost entirely completed before the opening of navigation, and the building of the pier revetment was nearly completed at the end of the year; and in a few days the contract with Messrs. Barker & Williams, dated February 9, 1871, will be com-

pleted. The one with these parties dated December 7, 1871, has been completed, and final payment made.

The excavation of the lock-pit for the new locks, which work is under contract with Messrs. Boyle & Roach, dated May 19, 1873, is nearly completed.

The completion of the excavation of pier revetment from section 142 east of the old canal locks will be placed under contract in a few days, and thereafter the stones required for the new lock-walls. It is extremely important and pressing that there should be no delay in constructing these locks. The old locks are breaking in several places, and they stand in need of repair. An attempt on the part of the agents of the State Board of Control to pump out the water with the aid of caissons this spring failed. If anything should happen to these old locks in the present condition of affairs to prevent their use, the effect on the immense and valuable commerce of the Lake Superior region would be ruinous. The tonnage passing through this canal is steadily on the increase, and the new locks are urgently necessary. Some passenger-steamers, having many passengers and large cargoes on board, are frequently delayed hours in waiting their turn to pass through. For this reason the whole of the appropriation asked for by me should be granted.

The amount of work done during the year was as follows:

Timber, feet, board-measure, delivered,	-	739,224
Plank, feet, board-measure, delivered	-	2,637
Iron, pounds, delivered	- - -	40,300
Framing, feet, board-measure, done	- -	521,496
Revetting wall, feet, done	- - -	11,015
Rock-excavation, cubic yards	- - -	57,828
Gravel excavation, cubic yards	- - -	87,256

The cost of the new locks, as estimated by my predecessor, General O. M. Poe, was in round numbers about \$1,160,000, as shown in detail herewith. This estimate was submitted in December, 1872, and approved.

60,000 cubic feet of pine-timber, 30 cents	-	\$18,000
1,300 cubic feet oak-timber, 50 cents,	-	650

540,000 feet, board-measure, pine plank and scantling, \$30	- - - - -	16,200
400,000 pounds wrought iron, 10 cents	-	40,000
1,620,000 pounds cast iron, 5 cents	- -	81,000
10,000 barrels of cement, \$3	- - -	30,000
30,000 cubic yards rock-excavation, \$3.50	-	105,000
90,000 cubic yards gravel, \$1	- - -	90,000
27,800 cubic yards masonry, \$27	- - -	750,000
1,100 cubic yards concrete, \$10.80	- -	11,880
30,000 cubic yards embankment, 50 cents	-	15,000
500 cubic yards slope walls and paved drains	-	1,000

Total	- - - - -	\$1,158,730
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Of this amount \$685,000 have been appropriated for the improvement of the Saint Mary's River and Saint Mary's Falls Canal. Of this amount about \$85,000 have been diverted for the improvement of the river and enlargement and improving of the canal. There remains, then, \$560,000 still to be appropriated under this estimate, and at least \$300,000 of this should be appropriated at once.

It is yet impossible for me to estimate the amount that will be required for the entire and permanent completion of this work. Three hundred thousand dollars can be profitably expended upon this work during the next fiscal year.

The work is situated in the Superior collection district, Michigan, at the Sault Saint Marie subport of entry, and a short distance from Fort Brady. The nearest light-house is at Round Island, and the nearest port of entry is Marquette.

The amount of revenue collected in the Superior district during the last fiscal year was \$6,235.34 coin and \$8,201.38 currency.

The whole commerce of the great chain of lakes will be benefited by the completion of this work.

This report is accompanied by a tracing of a diagram, showing the elevation of the surface of the water on the Saint Mary's Falls Canal above the datum plane of the survey of 1870, during the fiscal year, and another tracing showing the work that was done during the same period.

I desire to add that the whole amount of funds available for this work will be under contract in a short time, and will, probably, barely suffice to purchase the face-stone. A failure to make the appropriation asked for would, therefore, stop the work during a season.

FINANCIAL STATEMENT.

Balance in Treasury of the United States July 1, 1873	-	-	-	-	\$524,038.00
Amount in hands of officer and subject to his check, (including \$20,472.52 percentage due on contracts not yet completed)	-	-	-	-	118,584.59
Amount appropriated by act approved June 23, 1874,	-	-	-	-	200,000.00
Amount expended during the fiscal year ending June 30, 1874,	-	-	-	-	261,599.24
Amount available July 1, 1874,	-	-	-	-	354,062.81
Amount required for the fiscal year ending June 30, 1876,	-	-	-	-	300,000.00

II—SURVEY OF HAY LAKE CHANNEL, SAINT MARY'S RIVER.

When I relieved my predecessor, Maj. O. M. Poe, Corps of Engineers, last May, I found that he had intended to ask for authority to make this survey. Upon my first visit to this river I was so impressed with the great benefit that would be derived from the improvement of this channel, by the large and constantly growing commerce of the Lake Superior region, that I wrote to you on the 31st of May, 1873, requesting authority to make it, and again on June 30, 1873, submitting an estimate of its cost.

By letter from your office, dated July 31, 1874, I was authorized to make it, and accordingly I organized a party to do the work, under charge of Mr. H. A. Ullfers, assistant engineer. The following is a copy of his report:

Detroit, Mich., August 6, 1874.

GENERAL:—

I have the honor herewith to report on the survey of Hay Lake channel, of St. Mary's River, Michigan, made last fall under your direction.

The object of the survey was to demonstrate the superior advantages of the Hay Lake channel over the one hitherto used—the Lake St. George channel.

These advantages are of a two-fold character. An inspection of the general map, herewith submitted, will show at a glance that Hay Lake channel offers decidedly the shortest and most direct route from Mud Lake to the Sault Ste. Marie's Canal. The difference in favor of this route amounts to almost precisely eleven miles, being thirty-eight miles by the Lake St. George route and twenty-seven miles by way of Hay Lake channel.

But this is not the only nor the principal advantage claimed for the proposed new route. It is well known that the Lake St. George channel is practicable only in daylight, and in bright weather at that, on account of its tortuous course and, in many places, narrow water-way. No vessel ever thought of passing it in night time, and if approaching it from either end a half hour too late to pass entirely through had to lose the whole night on that account.

The plan for opening the Hay Lake channel is not the most economical one that could have been devised. If the question had been merely to shorten the route from Lake Huron to Lake Superior by eleven miles, advantage could have been taken of deeper water, involving far less excavation, and consequently at much less cost.

But this would have involved a more devious course, and would have defeated the second object, which appears to be of much greater importance, that of affording an opportunity of establishing range-lights, so as to render navigation in night time feasible. The lines proposed and laid down in the accompanying maps require four sets of range-lights, which, if established, would render navigation in night time entirely secure, except, of course in foggy weather.

The following estimates of cost are based on the soundings and borings made during last fall. The water at that time was on an average one foot higher than low water as ascertained by the gauge at the foot of the canal. The

soundings were accordingly reduced so as to apply to low water.

The work would have to be divided into four sections, differing from each other in their character.

The first or upper section comprises the Sugar Island rapids, and partly cuts through several of the numerous islands of that region. The bottom of the river and the soil of the islands is composed of clay, with ridges of small bowlders. From the small number of borings which could be made last fall it is impossible to give the exact proportion of clay and bowlders, but it will not be far out of the way to assume it as two-thirds clay and one third of bowlders. The calculations have been made accordingly.

The second section embraces the flats at the head of Hay Lake. They are of small extent, and composed entirely of sand.

The region occupied by the third section at the foot of Hay Lake is of much greater extent, but also composed of sand exclusively. Some provision will have to be made here to prevent filling up after the excavation is made.

The fourth section, comprising the West Neebish rapids, is, although small in extent, by far the most expensive. The bottom consists almost exclusively of limestone rock in thin layers, and has to be taken out by means of cofferdams. These will, of course, be quite expensive, but as the quantity of rock to be quarried out of each is quite large, I feel justified in estimating the price per cubic yard at four dollars, and expect that it can be done for less.

ESTIMATES.

Section 1.—Sugar Island Rapids:

780,090 cubic yards excavation ($\frac{2}{3}$ clay and $\frac{1}{3}$ bowlders), 40 cents.	- - - - -	\$312,036
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Section 2.—Flats at head of Hay Lake:

180,260 cubic yards excavation (sand), 25 cents.	-	45,065
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Section 3.—Flats at foot of Hay Lake:

1,223,898 cubic yards excavation (sand), 25 cents	305,974
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Section 4.—West Neebish Rapids:

527,046 cubic yards excavation (rock), \$4	-	2,108,185
<i>Grubbing and Clearing:</i>		
21½ acres, partly in small timber and partly in		
grass, at \$25 per acre,	-	537
<i>Range-lights:</i>		
Four sets, at \$20,000,	-	80,000
		<hr/>
Total,	-	2,851,797
Add 10 per cent. for contingencies,	-	285,180
		<hr/>
		3,136,977

All these calculations are based upon a prism of excavation 300 feet wide at the surface, with a slope of $2\frac{1}{2}$ to 1. In the case of the rock excavation this might properly be reduced to a width of 200 feet, with vertical sides, which would materially lessen the cost.

Herewith submitted are eight sheets of maps comprehending—

One general map of St. Mary's River, showing the route at present used and also the new one proposed.

Four sheets of special maps, showing the soundings and topography of each of the four sections.

Two sheets of maps on a smaller scale, showing the lines of the proposed channel connectedly.

One sheet of profiles and levels.

Respectfully submitted,

H. A. ULLFERS,

Assistant Engineer.

General G. Weitzel, Major Corps of Engineers, U. S. A.

It would be a great benefit to commerce if this improvement could be made. The channel at present navigated can only be used in day-time, and is very dangerous in places. Frequently many hours are lost by vessels carrying passengers and valuable cargoes, and thus causing great loss. Besides, if the channel could be improved, it could be lighted and buoyed in a proper manner, as it lies entirely within our territory and besides it is eleven miles shorter.

But, as the cost of improvement is so great, I respectfully

recommend a further survey of other channels, to ascertain if a cheaper and more feasible one cannot be obtained.

The drawing to accompany this report will be sent in a few days.

J

Report upon the Improvement of St. Mary's Falls Canal and River, by General G. Weitzel, Major of Engineers, U. S. A., for the Fiscal Year Ending June 30, 1875.

Ever since this work has been begun, it has been under the local charge, as civil assistant, of Mr. Alfred Noble. From his annual report to me, and from my knowledge of the work, this report of operations during the fiscal year ending June 30th, 1875, is made up.

The contract of Barker & Williams, dated December 7, 1871, was completed during the year, and final payment was made July 28, 1874.

These parties had not quite completed their work under their contract dated February 9, 1871, when navigation closed. A small amount of rock-excavation at the site of the dam which had been placed across the bed of the canal, near section 30, west, remained to be done. Upon the contractors giving bond that they would do this work this spring I was authorized to make final payment, which I did on the 23d of December, 1874. They have been at work to complete this excavation, but up to the latest accounts had not yet succeeded.

Messrs. Boyle & Roach have been engaged during the year under their contract, dated May 19, 1873, in excavating the lock pit for the new locks and placing the lock-floor. They will probably complete this contract on the 15th of August, when the construction of the new lock-walls will be begun.

● The only work that was done during the winter was constructing the pier on the north side of the canal adjacent to the old locks, more specifically from section 142 to section

179. This work was done by Barker & Son, under their contract dated September 29, 1874, and was completed just on time.

During the year the delivery of the face stone for the new locks was placed under contract. There were two lettings for this. One on the 31st of October, 1874, and the other on the 18th of March, 1875. The lowest bidders at the first letting were Messrs. Saxton & Salter. They were both American citizens, but proposed to furnish the stone from their quarry near Port Colborne, Canada.

The honorable the Secretary of the Treasury decided that they would be compelled to pay duty on their stone, because the contract was that I would not accept the stone until it was delivered on the work. They, therefore, were allowed to withdraw their bid, as it was made with understanding that their stone should come in free, and I was ordered to re-advertise.

The successful bidder at the second letting was Mr. August Wallbaum, of Chicago. He proposed to furnish a fine limestone from Sagetown, Ill., on the line of the Chicago, Burlington & Quincy Railroad. He entered into contract dated March 29, 1875.

In order to procure a good dock for landing the large amount of material which will be required in the construction of the new locks, it was decided to build at once about 500 feet of the proposed pier on the south side of the entrance to the enlarged canal. C. C. Barker & Son were the successful bidders, and entered into contract dated May 22, 1875, but at the latest accounts had not yet begun the work. They are in default now, and unless something is done soon by them I will recommend that the work be taken from them.

All of this work having been placed under contract, I next advertised for bids for building the new lock, the contractor to accept the face stone as delivered by Mr. Wallbaum, and he to furnish the backing and sand. In order to be sure that none but good cement should be used, I imposed upon myself, for the Government, the duty of furnishing it.

The bidding for this work on the 22d of May, 1875, was quite spirited, and Messrs. Boyle & Roach, of Cincinnati, were successful. They entered into contract dated May 29, 1875.

The abstracts of bids received for labor and material on this work, and abstract of estimates of materials delivered and labor performed under several contracts, and an exhibit of purchase of timber and iron in open market during the fiscal year, are hereto attached and form part of this report.

Since the beginning of the work on the new locks, \$885,000 have been appropriated for the improvement of the Saint Mary's River and Saint Mary's Falls Canal. Of this amount about \$85,000 have been diverted for the improvement of the river and enlargement and improving of the canal. There remains, then, \$360,000 to be appropriated for them, in order to come up to the original estimate, as given in detail in my last annual report.

Of this sum I recommend, for the sake of economy in prosecuting the work, that the sum of \$300,000 be appropriated for the fiscal year ending June 30, 1877. I hope in my next annual report to be able to estimate the amount required for the entire completion of the work. At present it is quite impossible to do so, but I believe that it will require but a small amount more, if the \$300,000 are appropriated, as I have recommended. All of the amount hereafter reported available, excepting that required for contingent expenses, is under contract, and therefore, really not available for other work.

The work is situated in the Superior collection district, Michigan, at the Sault Ste. Marie subport of entry, and a short distance from Fort Brady. The nearest lighthouse is at Round Island, and the nearest port of entry is Marquette.

The whole commerce of the great chain of lakes will be benefited by the completion of this work.

FINANCIAL STATEMENT.

Balance in Treasury of United States July 1,

1874 - - - - -	\$524,038.00
Amount in hands of officer and subject to his check (including \$46,960.54 percentage due on contracts not yet completed) July, 1,	
1874 - - - - -	56,985.35
Amount appropriated by act approved March 3, 1875 - - - - -	200,000.00
Amount expended during the fiscal year en- ding June 30, 1875 - - - - -	178,026.90
Amount available July 1, 1875, including \$23,343.98 due on contracts - - - - -	602,996.45
Amount required for the fiscal year ending June 30, 1877 - - - - -	300,000.00

K

Report upon the Improvement of St. Mary's Falls Canal and River by General G. Weitzel, Major of Engineers, U. S. A., for Fiscal Year Ending June 30, 1876.

This report, like all of those heretofore made upon this work, is based upon the records in my office, my personal knowledge of the work, and the annual report to me of Mr. Alfred Noble, who is, as civil assistant, in immediate charge of the work.

Messrs. Barker & Williams completed their work under the contract dated February 9, 1871, in the month of October last. They had a great deal of difficulty and large expense in doing this on account of the depth of the water in which they were compelled to work, and in consequence of the continued interruption to their work by passing vessels.

Messrs. Boyle & Roach completed the excavation of the pit, and placing the floor to receive the new locks, during last November. This work was done under the contract dated May 19, 1873.

The portion of the pier on the south side of and below the proposed new locks, and the excavation incident thereto, were finished during the month of May, 1876. This work

was done by Messrs. C. C. Barker & Son, under the contract dated May 22, 1875.

I have ordered the space between this pier and the shore to be filled up with material taken from the spoil-banks. The room thus created, together with the pier, will make a good dock for receiving and handling the large quantity of stone and material required in the construction of the new locks. I stated in my last annual report that I had entered into contract with Mr. August Wallbaum, of Chicago, for the delivery of the face-stone required for the new locks. He entered into contract on the 29th of March, 1875. Before much time had elapsed, doubts were created in my mind of his ability to fulfill his contract by the reports of my assistants who visited the quarries. I therefore placed an inspector on duty at the quarry to give me weekly reports of the progress, and to inspect all the stone that was quarried. These reports were continually unfavorable, and I warned Mr. Wallbaum several times, and also gave notice to his sureties. After having waited as long as I possibly could, and seeing no prospect ahead that the contractor had the means or even the quarries to furnish the stone, I asked for authority on the 28th of February, 1876, to annul his contract. This was granted, and I was directed to re-advertise. The bids under this were opened on the 17th of March, 1876. The lowest bidder for suitable stone was Mr. F. D. Van Wagenan, of Fulton, N. Y. He, however, did not enter into contract, and it was then awarded to Mr. Henry Van Vleck, of Syracuse, N. Y. He promptly entered into contract, and is now engaged both at Marblehead and Kelly's Island, Ohio, in quarrying suitable stone, and has already delivered a few on the work. As soon as sufficient stone are delivered to warrant the contractors for building the walls (Messrs. Boyle & Roach) to begin, they will do so. They are making all the preliminary arrangements now, and I think that the first stone will be set about the latter part of this month. By this trouble with the contractors and bidders for the face-stone, the construction of the new locks has been delayed about three months; but it was impossible,

under the law and my instructions, to avoid this misfortune. Upon my request, proceedings have been begun by the Government against Messrs. Wallbanm and Van Wagenan.

Failing contractors and bidders should be punished to the full extent of the law, or the progress and economical execution of our public works will be at the mercy of incompetent and speculating bidders. As soon as these locks are completed, there will remain to be done, in order to complete the work in accordance with the original project, the excavation at the head of the new and old locks, and at the foot of the former; the unfinished pier revetment of these excavations; the construction of new guard-gates at the head of the old locks, and the removal of the old guard gates. The approximate estimate for the cost of these unfinished portions is, as nearly as can yet be determined, as follows, viz:

145,000 cubic yards of excavation, at 75 cents	\$108,750
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Revetment:

212,200 cubic feet of timber in place at 30 cents	63,660
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160,000 pounds of iron, at 3½ cents	- 5,600
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45,000 cubic yards of filling, at 40 cents,	- 18,000
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Guard-gates at head of old locks and masonry therefor	- - - - - 40,000
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Removing old guard-gates,	- - - - - 20,000
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256,010

Contingencies	- - - - - 33,990
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290,000

Deduct value of timber and iron on hand, about	25,000
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265,000

The original estimate for the cost of the new locks was	- - - - - 1,160,000
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The total original estimate for the completion of the new locks and the remainder of the work, according to the present approved project, is, then	- - - - - 1,425,000
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In addition to this approved project, I now respectfully sub-

mit one for the improvement of the upper entrance of the canal. There is a curve in it which is a source of great loss of time and money, and may be the source of serious injury to the vessels using the canal. The entrance is narrow, with shoal water on the south side of it, and the current produced by the falls is almost directly across it. As stated in my letter dated April 25, 1876, to the Chief of Engineers, the larger number of vessels passing the canal arrive in tows containing two to six vessels each. It is not considered safe by tug-captains to bring in more than one, and at most two vessels at a time; the tow, if containing more than this number, must be broken up and a part left at anchor outside, to be brought in subsequently. Approaching the entrance, the vessels drift across it rapidly. As soon as the tug passes the end of the pier it is in still water, but the rear vessels continue drifting, often barely making the entrance. They then have a direction oblique to the canal, sometimes striking the piers heavily, and alternately on opposite sides, and they are hardly brought under control until the guard-gates, 1,700 feet below the entrance, are reached. In its present condition the upper entrance to the canal is a constant source of danger and delay to navigation, and a constant cause of injury to the revetment of the canal. Any plan of improving the canal which leaves this entrance as it now exists would be an imperfect one.

The additional project now submitted comprises straightening the south bank of the canal, building a pier on the new line to deep water, and excavating to canal-bottom the area between the new pier line and the present channel; this would more than double the width to the entrance, and tows of vessels would make it under shelter of the south pier without delay or danger.

The estimated cost of this additional project is as follows, viz:

115,000 cubic yards of earth-excavation, at 30 cents.	\$ 44,500
30,000 cubic yards excavation, (gravel, boulders, and old piers,) at 75 cents.	22,500

1,300 cubic yards rock excavation, at \$4	-	52,000
200,000 cubic feet of timber in pier, at 27 cents		54,000
125,000 pounds iron bolts at 3 cents	-	3,750
40,000 cubic yards filling in behind pier, at 35 cents	-	14,000
		<hr/>
		190,750
Add for contingencies and superintendence	-	19,250
		<hr/>
		210,000

The total estimated cost of the project as now approved, since the new locks were begun as above stated, being \$1,425,000, if the additional project submitted by me is approved, the total estimated cost of the work since that time, finished completely and thoroughly, is \$1,635,000. I think, however, that this may safely be cut down to 1,500,000, (unless something unforeseen happens,) in consequence of the fact that I am obtaining labor and material for the new locks at cheaper rates than assumed in the original estimate. Assuming, then, \$1,500,000 as the estimated cost of this whole work from the point above mentioned, there remains to be appropriated, as will be seen from my last annual report, the sum of \$700,000, less the amount which may be appropriated by Congress at its present session. For the sake of an economical and rapid prosecution of the work, the sum of \$300,000 should be appropriated for this work for the fiscal year ending June 30, 1878. Every cent of the money which is now available for this work is covered by contracts.

It is contemplated during the present fiscal year to build as much of the new lock-walls as is possible, and to begin the work of straightening the west entrance to the canal, if the project is approved. The probable progress that will be made depends upon the energy of the contractor for the face-stone, who has just commenced work. As I know but very little about him, I cannot even give a fair guess on the subject. At least one-eighth of the new lock-walls should be completed during the season; not more can be expected,

because there are always delays in the beginning of such works. The whole amount appropriated since the enlargement of this canal was begun is as follows, viz:

1870	-	-	-	-	-	\$150,000.00
1871	-	-	-	-	-	350,000.00
1872	-	-	-	-	-	300,000.00
1873	-	-	-	-	-	200,000.00
1874	-	-	-	-	-	200,000.00
1875	-	-	-	-	-	200,000.00

Total	-	-	-	-	-	\$1,400,000.00
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Of this amount, about \$600,000 was expended before and during the excavation of the pit for the new locks, in widening and deepening the canal proper, revetting the sides of the enlarged canal, purchase of additional lands, and in improving the Saint Mary's River. Of the other \$800,000, about \$400,000 have been expended on the lock-pit and other portions pertaining to the new locks, and about \$400,000 was on hand at the end the fiscal year. In exact figures this amount was \$396,189.93.

An abstract of materials delivered, and labor performed under contract, an exhibit of timber, plank and iron purchased in open market, and an abstract of bids received on the 17th of March, 1876, for furnishing the face-stone for the new locks, are attached and form part of this report.

The work is situated in the Superior collection-district, Michigan, at the Sault Sainte Marie, subport of entry, and a short distance from Fort Brady. The nearest light-house is at Round Island, and the nearest port of entry is Marquette. The amount of revenue collected in the Superior district during the last fiscal year was, coin, \$3,714.41; currency, \$8,542.92.

The whole commerce of the great chain of lakes will be benefited by the completion of this work.

ABSTRACT OF MATERIALS DELIVERED AND LABOR PERFORMED
UNDER CONTRACT AT THE ST. MARY'S FALLS CANAL DURING THE
YEAR ENDING JUNE 30, 1876.

Rock-excavation, cubic yards	-	-	-	556
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Gravel-excavation, cubic yards	-	-	-	37,602
Timber, cubic feet	-	-	-	25,618
Plank, feet, board-measure	-	-	-	227,774
Framing, feet, board-measure	-	-	-	1,784,574
Iron, pounds	-	-	-	39,703
Cement, barrels	-	-	-	4,609
Concrete, cubic yards	-	-	-	3,628
Filling, cubic yards	-	-	-	5,563

EXHIBIT OF TIMBER, PLANK AND IRON PURCHASED IN OPEN MARKET DURING THE YEAR ENDING JUNE 30, 1876.

Timber and plank, feet, board-measure	.	1,612,155
Iron, pounds	- - - -	80,422

MONEY STATEMENT.

Amount available July 1, 1875	- - -	\$602,996.45
Amount expended during fiscal year ending June 30, 1876	- - -	205,768.52
Amount available July 1, 1876	- - -	397,227.93
Amount appropriated by act approved August 14, 1876	- - -	130,000.00
Amount (estimated) required for completion of existing project	- - -	570,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1878,	- - -	300,000.00

L

Report upon the Improvement of St. Mary's Falls Ship Canal and River, by General G. Weitzel, Major of Engineers, U. S. A., for the Fiscal Year ending June 30, 1877.

At the beginning of the fiscal year, there were but two contracts in force for the further prosecution of this work.

The one was with Mr. Henry Van Vleck, for furnishing the face-stone for the new locks, and the other with Messrs. Boyle & Roach, for furnishing the backing and laying the walls of the same. In order that there may be no doubt whatever about the quality of the mortar to be used, I deliver the cement.

We use the English Portland cement for laying the face-stone and the miter and lift-walls, and all portions of the wall adjacent to wet places.

For the remainder of the walls we use American cements, and so far, chiefly that obtained from the vicinity of Louisville, Ky.

The work made but very slow progress during last season, on account of the slow delivery of the face-stone; but during the present season there has been a great improvement. The amount of face-stone required is a little over 10,000 cubic yards, and the amount of masonry in the walls is about 27,000 cubic yards. At the end of the fiscal year, about one-fifth of the face-stone had been delivered and about one-sixth of the masonry laid.

In addition to the operations which were carried on under these two contracts, two other smaller pieces of work were done by day's labor. The one was filling in the area between the south pier at the foot of the new locks and the shore line. This pier was built during the preceding year, and there was a considerable area between the inside of it and the shore line which was covered with water. We filled in this area to the level of the top of the pier and the shore, and we have thus obtained, in close proximity, excellent yard-room for unloading, storing and handling the large amount of material required in the construction of the new locks. The other consisted in raising the banks of the canal, near its lower end, to a height of from 2 to 4 feet by means of levees. This was done to guard against such events as occurred on the 23rd of June, 1876. On the morning of that day the water in the canal suddenly rose to about 4 feet, and was running over the banks. If it had not been promptly checked in its flow, the most disastrous results might have occurred at the lower end of the canal in the destruction of the banks which are here comparatively weak.

To supply a want which I understand, has been felt by some of my brother officers of the corps in the various annual reports on this improvement, I introduce here a brief historical and descriptive sketch of the work, which by my direction was prepared by my civil assistant on the work,

Mr. Alfred Noble. Mr. Noble has occupied his present position ever since the enlargement was begun.

The Saint Mary's Falls Canal is situated near the village of Sault Ste. Marie, Mich., at the principal rapids in Saint Mary's River. This river or strait is the outlet of Lake Superior. The canal is 15 miles from Lake Superior and 60 miles from Lake Huron by the navigable channel of the river.

The rapids at this point are a little more than one-half mile in length, and have a fall of from $16\frac{1}{2}$ to $18\frac{1}{2}$ feet, depending upon the stages of water in the lakes which the river connects; the mean fall being very nearly 18 feet. From Lake Superior to the rapids the fall is only one-tenth of a foot; from the rapids to Lake Huron the fall is about 2 feet, distributed through a distance of 20 miles. These rapids, the Sault de Ste. Marie, are therefore the only impediment of this nature obstructing navigation between the lakes.

The commerce of Lake Superior before the year 1845 was almost entirely in furs; at that time the development of copper and iron mines was commenced, and the rapids at this place were found to be a serious obstacle in the way of the successful prosecution of these enterprises. The products of the mines, the appliances for working them, and the supplies for the laborers had to be unloaded from the vessels on which they were brought here, transported past the rapids and re-shipped. Finally in 1850, a grant of 750,000 acres of land was made by act of Congress to the State of Michigan to defray the cost of constructing a canal past the rapids.

In 1853, the legislature of the State having accepted the grant and authorized the construction of the work, a contract was made by commissioners, appointed by the Governor, with a company who undertook to build the canal for the land grant. The work was commenced soon after the opening of navigation in that year, and on the 18th of June, 1855, the completed canal was opened to navigation.

In its construction the company had expended about \$1,000,000. In view of the large amount of capital required, no return being possible until after the sale of lands, the isolation of the locality, inaccessible during five months of the year, and the severity of the climate which greatly retarded work during winter, the rapid construction of the canal was a remarkable feat.

This was about the first ship-canal made in the United States. The locks and gates were the largest made in the country up to that time. The depth of water was the greatest that had been called for in any similar American work. The engineering features were thus without precedent in American practice; but they were well worked out, and the canal has proved to be a very successful one.

As originally built, the canal was 5,400 feet long, had a width of 100 feet at the water line, with slopes of $\frac{1}{2}$ to 1, paved where the cutting was not through rock, and a depth of 12 feet at mean stage. The locks, located near the foot of the canal, were two in number, combined, each 350 feet in length, 70 feet in width, with a lift of 9 feet. The walls were of limestone obtained from Marblehead, Ohio, and Malden, Canada; the backing from Drummond's Island, near the mouth of Saint Mary's River. The face-stone were laid in regular courses with irregular bond; had bush-hammered faces with $1\frac{1}{2}$ inch margin draft, and joints had beds cut to $\frac{3}{8}$ inch. The general plan of the masonry is shown in plate III.

It is not known that rock was reached anywhere in the excavation for the locks at the grade required for the floor. The walls were laid on a floor which extended across the chambers.

The floor was made of timber and plank, the timbers laid across the pit, with spaces of 6 inches or one foot between, and covered with two courses of plank. There is a longitudinal string-timber under the floor under the face of each wall, and two others near the center of the lock; wherever the excavation reached nearly to the rock, trenches were made to the rock on the sites for the last two timbers, and timber walls, 1 foot thick, secured to the rock with fox-

wedged bolts, were built from the surface of the rock to the required grade.

The gates were of wood; the girders were built beams framed into quoins and miter-posts and trussed with iron tie-rods. On Plate IV. is a drawing of one of the gates about to be placed between the locks, differing only in a few minor details from the original ones.

Each gate is opened by a line and closed by a boom. The power, manual labor, is applied through a capstan on the wall. Both the line and the boom are attached to the top of the gate at the miter-post. This gear is decidedly primitive, and seems objectionable, inasmuch as the strain is applied at that part of the gate farthest from the center of resistance; but it is simple, and easily and quickly repaired; the fact that the original gates stood and were operated without accident or delay for more than 20 years shows that they never have sustained serious injury from any cause. Each gate is supported on a pivot resting on the floor of the lock and entering a socket in the foot of the quoin-post, and is suspended from a tower 7 feet in height, resting on the coping at the hollow-quin. There is no roller at the miter-post. The gates are opened or closed in from three to four minutes.

Near the bottom of each gate are six openings, each 2 by 4 feet, for the admission or escape of water; each opening is closed by a cast-iron butterfly valve, operated by a rack and pinion at the top of the gate. Each lock is filled or emptied in about 7 minutes.

At the foot of each wall a check was made to receive the end of a caisson-gate, which rested also against a sill laid across the floor. This was to be used in case it should be desired to pump out the lock, but does not fulfill its purpose, because the water presses under the floor and comes through it above the caisson sill.

At the head of the canal was placed a guard-gate, with its appropriate masonry. The opening was 70 feet. The gate was a caisson, hinged at one end, and of sufficient length to close the opening. This was found inconvenient, and in 1862 a pair of ordinary lock-gates, with the proper

masonry, was placed farther down the canal in the position indicated in Plate I.

The entrance to the canal were revetted with piers. The south piers were built originally as shown in Plate I., no extension having been made up to the time of commencing the improvements. The north piers originally extended only to the shore lines, but were lengthened subsequently.

At the time the canal was made it was deemed of sufficient capacity in every way to meet the needs of navigation. The depth was sufficient to pass any vessel on the lakes fully laden. The locks were large enough to contain a tug and three vessels of ordinary dimensions, which generally constituted a tow. By the year 1870, these dimensions no longer sufficed. Vessels were larger and were not able to carry full loads on 12 feet of water; only one of the larger vessels could be passed at one lockage, and the number of vessels engaged in the Lake Superior trade had increased so greatly that they were frequently delayed several hours. It became necessary to provide for more rapid lockage and for the passage of larger vessels. The slope-walls had been found objectionable, vessels coming in contact with them below the water-line and sustaining injuries. In July, 1870, Congress made an appropriation for commencing the improvements. In August, 1870, a project was submitted by Maj. O. M. Poe, Corps of Engineers, and received the approval of the Chief of Engineers. The project, after some amendments, embraced the following improvements:

A new lock was to be built opposite the old locks, parallel to them, at a clear distance of 100 feet.

The guard-gates, with their masonry, were to be taken down and replaced 700 feet farther up the canal and at a lower level.

Entrances to the new locks were to be formed, the lower entrance by excavating out to deep water and revetting the channel with pier-work; the upper entrance by widening the canal from the new position of the guard-gates, where the original width was retained, eastward until it became wide enough to open the way to both the old and new locks.

The slope-walls were to be removed and a timber revet-

ment, with a face nearly vertical, substituted; where the cutting was through rock, the revetment was placed on the first sound rock reached; below the base of the pier the rock was cut to a slope of 1 horizontal to 4 vertical; where no rock was found, the revetment was to be built from the grade of improved canal-bottom.

The improved canal was to be made $3\frac{1}{2}$ feet deeper than than before the improvements were taken in hand.

The walls of the old locks are to be prolonged up stream to receive a pair of guard-gates.

At the time the canal was made, danger was apprehended that ice might be driven into the canal in the spring to such an extent as to delay its opening for navigation. To guard against this, a curve was made near the upper end, so that the direction of the canal above the curve was nearly normal to the direction of the current in the river, which is rapid. This renders the entrance rather difficult for a single vessel, and impracticable for a tow of three or more. It is now known that there is no danger of delay by ice. The south side of the canal will therefore be straightened and the present south pier above the bend removed. The new south pier will be extended farther out, as shown on Plate II.

The chamber of the new lock will be 515 feet long and 80 feet wide. The width at the gates will be 60 feet. A pair of guard-gates will be placed at each end of the chamber. The lift of the lock will be 18 feet; the depth of water on the miter-sills, 17 feet. The miter-sills are to be placed 1 foot below canal bottom, so as to be protected from injury by vessels.

The foundation is on rock throughout. The rock is a sandstone of different degrees of hardness; some layers being very friable, so as to be excavated easily with a pick and shovel; some exceedingly hard. A floor of timber and concrete was made extending across the bottom of the lock and 5 feet under each wall.

The lock will be filled through two culverts under the floor, each 8 feet square in cross-section and extending the length of the lock; the water will enter the lock through numerous small openings in the top of the culverts. It will

be emptied through two shorter culverts under the lower lock-gates. The floor and walls of the culverts are of timber.

The gates and valves in the culverts will be operated by water-power.

After the completion of the new lock, it is proposed to remove the guard-gates near the head of the canal, and erect in their place a movable dam.

At this time the guard-gates have been moved 700 feet above the location shown in Plate I. The canal has been deepened and widened, the slope-walls removed, and the timber revetment built (except the work for straightening the south bank of the canal) from the upper end to the basin. On the north side of the canal the slope-wall has been removed and the pier-revetment completed to the head of the old locks. The pier for the south side of the lower entrance has been completed to within 200 feet of the end of the lock-wall, the lock-pit has been excavated, the culverts and floor and about 4000 yards of the masonry laid.

The excavation from the head of the canal to the basin was principally in rock. In excavating the lock-pit, rock was reached at from 1 foot to 15 feet above the grade of lock floor.

Until May 1, 1873, the work was under the charge of Maj. O. M. Poe, of the Corps of Engineers; since that time it has been under the charge of Maj. G. Weitzel, of the Corps of Engineers.

It seems proper for me to add to this sketch that the original canal was designed and begun under the superintendence of the late Capt. Augustus Canfield, Corps of Topographical Engineers.

The appropriation of \$130,000, made by the act approved August 14, 1876, for continuing the improvement, was made available by letter from the Chief of Engineers, dated May 1, 1877. A project for its expenditure was submitted and approved. It included dredging at the head of the canal, with a view to straightening the south bank thereof.

Bids for this were opened on June 20, 1877, and the contract awarded to Charles S. Barker, of Sault Ste. Marie, Mich., he being the lowest responsible bidder.

The last passage through the canal in 1876, was on December '4. The first passage through in 1877 was on May 2.

During the year, 54,637 cubic feet of cut face-stone have been delivered, 113,373 cubic feet of masonry laid, and 6,409 barrels of cement purchased.

The work will be prosecuted during the present working season under the three contracts above referred to. If nothing unforeseen occurs, fully two-thirds of the face-stone will be delivered, one-half of the masonry of the new locks laid, and all of the dredging at the head of the canal done at the end of the present working season.

The operations contemplated in the fiscal year 1877-'78, are to carry the new locks toward completion, and to begin the pier revetment on the south side of the head of the canal.

In order to complete this work according to the project, there remains to be appropriated the sum of \$570,000.

For the sake of an economical and rapid prosecution of the work, the sum of \$300,000 should be appropriated for the fiscal year ending June 30, 1879.

The whole amount appropriated since the enlargement of this canal was begun, is as follows, viz:

1870	-	-	-	-	\$ 150,000.00
1871	-	-	-	-	350,000.00
1872	-	-	-	-	300,000.00
1873	-	-	-	-	200,000.00
1874	-	-	-	-	200,000.00
1875	-	-	-	-	200,000.00
1876	-	-	-	-	130,000.00
Total,	-	-	-	-	\$1,530,000.00

Of this amount about \$600,000 was expended before and during the excavation of the pit for the new locks, in widening and deepening the canal proper, revetting the sides of the enlarged canal, purchase of additional lands, and in improving Saint Mary's River. Of the other \$930,000, about \$520,000 have been expended on the lock-pit, walls, and other portions pertaining to the new locks, and about \$410,000 were on hand at the end of the fiscal year.

In exact figures this amount was \$410,213.06. But all of this sum, except \$30,000, is covered by liabilities and is therefore not available for the work which still remains to be done and should be commenced as soon as possible.

An abstract of bids received on June 30, 1877, for dredging at the head of the canal, is attached and forms part of this report.

The work is situated in the Superior collection-district, Michigan, at Sault Ste. Marie, port of delivery, and a short distance from Fort Brady. The nearest lighthouse is at Round Island, and the nearest port of entry is Marquette, Mich. The amount of revenue collected in the Superior district during the last fiscal year was, in coin, \$2,026; in currency, \$8,415.

The whole commerce of the great chain of northern and northwestern lakes will be benefited by the completion of this work.

MONEY STATEMENT.

July 1, 1876, amount available	\$397,227.93
Amount appropriated by act approved August 14, 1876	130,000.00
	<hr/> 527,227.93
July 1, 1877, amount expended during fiscal year	108,213.84
	<hr/> 419,014.09
July 1, 1877, amount available	419,014.09
Amount (estimated) required for completion of existing project	570,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1879	300,000.00

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Report upon the Improvement of St. Mary's Falls Canal and River, by General G. Weitzel, Major of Engineers, U. S. A., for the Fiscal Year ending June 30, 1878.

The progress of this work during the past fiscal year is given in the appended report of Mr. Alfred Noble, civil assistant, in immediate charge of the improvement.

The contractors for laying the masonry of the new locks have used and are now using due diligence in prosecuting their work, and had the contractor for furnishing the stone been able to fulfill his contract by the specified date, the lock-walls would have been completed during the present season. If the delivery of face-stone is finished this year, the masonry will be completed early next season.

As during previous years, to secure the most perfect work, the government has continued to furnish cement for mortar and concrete. English Portland cement has been almost exclusively used for all face-stone and exposed parts of the work. For other portions of the wall, the American natural and Portland cements have been used. Mr. Noble has carried on in connection with this work an elaborate system of tests of all cements furnished for the work. These tests will be continued until the completion of the work and will furnish most valuable information as to the strength and quality of the various kinds.

The time has arrived when it is desirable for the good of the improvement that the management and control of the present canal should pass into the hands of the government.

To ascertain the present amount of the canal debt, which in accordance with act of the Michigan Legislature is to be assumed by the United States as the only condition of transfer, a correspondence of which the following is a copy, was entered into with His Excellency, Governor Croswell, of Michigan:

"U. S. Engineer Office,
"Detroit, Mich., April 30, 1878.

"His Excellency
"CHARLES M. CROSWELL,
"Governor of Michigan,
"Adrian, Michigan.

"SIR:—

"With a view of recommending in my next annual
"report the acceptance of the St. Mary's Falls canal in
"accordance with the joint resolution of the Michigan State
"legislature, approved April 3, 1869, I would respectfully

"ask for information as to the terms upon which the transfer will now be made and the amount of the indebtedness to be assumed by the government.

"Very respectfully,

"Your obedient servant,

"G. WEITZEL,

"Major of Engineers, U. S. A."

REPLY.

"State of Michigan,

"Executive Office,

"Adrian, May 1, 1878.

"Gen'l. G. WEITZEL,

"Maj. of Engineers, U. S. A.,

"Detroit, Mich.

"SIR:—

"I have yours of the 30th ult. asking information as to the terms upon which the St. Mary's Falls canal will be transferred to the United States, together with the amount of indebtedness thereon to be assumed by the general government. I will call the attention of the Canal Board at its next meeting to the subject of your communication and advise you of the action taken in reference thereto.

"Yours very resp'y,

"CHARLES M. CROSWELL."

As no further information has been furnished, it is probable the Board of Control have not yet taken any action in the matter.

The extremely low stage of water in the St. Mary's river this year has rendered navigation more troublesome than usual. To remedy this as far as possible authority was granted to remove the worst obstructions at three points in the river. This work has been commenced.

Work has been delayed during the past year by reason of the small amount of money available and, as the appropriation which becomes available July 1st, 1878, is much less than the amount which it is thought could be profitably expended during the coming fiscal year, it is probable the

work can not be pushed forward quite as rapidly as was expected.

In order to complete this work according to the project, there remains to be appropriated the sum of \$395,000.00.

For the sake of an economical and rapid prosecution of the work this entire sum should be appropriated for the fiscal year ending June 30, 1880.

The work will be prosecuted during the present working season under the present contracts and by day's labor. If nothing unforeseen occurs, all the stone will be delivered, the lock walls will be almost completed, work on the south pier will be continued and a few obstructions will be removed from the river.

The operations contemplated in the fiscal year 1878-'79, are to complete the masonry of the new locks, build the gates, complete the pump-house and continue work on the new south pier, and the straightening of the canal.

The whole amount appropriated since the enlargement of this canal was begun, is as follows, viz:

1870	-	-	-	-	-	\$150,000.00
1871	-	-	-	-	-	350,000.00
1872	-	-	-	-	-	300,000.00
1873	-	-	-	-	-	200,000.00
1874	-	-	-	-	-	200,000.00
1875	-	-	-	-	-	200,000.00
1876	-	-	-	-	-	130,000.00
1878	-	-	-	-	-	175,000.00
Total	-	-	-	-	-	\$1,705,000.00

Of this amount about \$600,000 was expended before and during the excavation of the pit for the new locks, in widening and deeping the canal proper, revetting the sides of the enlarged canal, purchase of additional lands and in improving St. Mary's river. Of the other \$1,105,000, about 760,000 have been expended on the lock-pit, walls, other portions pertaining to the new locks, and in straightening the canal at its upper entrance; and about \$345,000 were on hand at the end of the fiscal year. Of this last amount \$170,000 is covered by liabilities under contracts, and is,

therefore, not available for the work which still remains to be done.

This work is located in the Superior collection-district, Michigan, at Sault Ste. Marie, port of delivery and a short distance from Fort Brady. The nearest light-house is at Round Island, and the nearest port of entry is Marquette, Mich. The amount of revenue collected in the Superior district during the last fiscal year was \$10,808.52.

The whole commerce of the great chain of northern and northwestern lakes will be benefitted by the completion of this work.

MONEY STATEMENT.

July 1st, 1877, amount available,	-	\$419,975.09
Amount appropriated by act approved June		
18, 1878,	- - - -	175,000.00
		<hr/>
		\$594,975.09
Amount expended during fiscal year,		294,345.47
		<hr/>
July 1st, 1878, amount available,	-	\$345,629.62
Amount (estimated) required for completion		
of existing project,	- -	\$395,000.00
Amount that can be profitably expended		
in the fiscal year ending June		
30, 1878,	- - - -	\$395,000.00

REPORT OF MR. ALFRED NOBLE, ASSISTANT, IN CHARGE.

Sault Ste. Marie, Mich.,
June 29, 1878.

Capt. A. MACKENZIE,
Corps of Engineers, U. S. A.,
Detroit, Mich.

CAPTAIN:—

I have the honor to submit the following report of operations at the St. Mary's Falls canal during the year ending June 30, 1878:

At the beginning of the year there were two contracts existing, one with Henry Van Vleck for furnishing face-

stone, and one with Boyle & Roach for furnishing the backing and laying the masonry of the new lock. On July 9, 1877, a contract was made with C. S. Barker, for dredging for the enlargement of the canal from the line for the new south pier to the present channel. Some difficulty was apprehended in placing the pier owing to the nature of the material on which it was to be founded; the framing and placing were, therefore, undertaken by hired labor.

The amount of work performed during the year is as follows:

Under contract of May 29, 1875, 18,683.46 cubic yards of masonry have been laid, and 6,853 cubic yards of earth have been placed behind the new lock walls.

Under contract of May 11, 1876, 128,512.23 cubic feet of face-stone have been delivered.

Under contract of July 9, 1877, 44,727 cubic yards of earth have been removed.

For the work of building the new south pier at the head of the canal, 1,190 lineal feet of crib-work have been built, and 1,070 lineal feet placed.

The cement for the walls of the new lock has been purchased in open market: 18,351 bbls. have been received.

A shoal in the river channel one mile above the canal has been dredged to 13 feet of water.

A tracing showing the present condition of the improvement and a diagram of the stage of water during the year are attached.

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COMMERCIAL STATISTICS

OF

LAKE SUPERIOR PORTS,

1878.

STATISTICS OF MICHIGAN, COMPILED BY CHAS. E. WRIGHT, M. E., COMMISSIONER OF MINERAL STATISTICS.

NAMES OF FURNACE COS.	Previous to 1872.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	TOTAL.
1 Pioneer Furnaces	57,577	7,050	7,388	10,708	15,302	11,306	2,801	9,700	121,001
1 Iron Cliffs Furnace	36,596	3,431	2,000	4,784	388	.....	.....	.....	51,132
1 Collins Iron Company [†]	15,059	4,350	4,100	3,688	5,277	3,282	.....	.....	41,997
1 Northern Iron Company [†]	35,021	4,356	6,324	5,973	5,377	3,278	.....	.....	15,060
1 Bancroft Iron Company [†]	31,602	5,006	3,049	1,581	5,377	.....	663	.....	55,018
1 Morgan Iron Company [†]	20,512	4,001	4,407	6,621	3,088	.....	.....	.....	57,573
1 Champion Iron Company [†]	23,344	4,212	4,416	4,839	1,366	.....	.....	.....	31,048
1 Michigan Iron Company [†]	25,140	4,212	4,839	1,366	.....	.....	.....	.....	40,282
1 Greenwood Iron Company [†]	24,626	9,992	11,079	10,647	10,015	.....	3,960	9,683	91,950
2 Fayette Furnace	7,557	2,500	2,257	6,092	4,230	2,407	3,280	.....	28,312
2 Munising Iron Company [†]	7,065	4,900	8,706	9,355	9,223	8,119	4,250	.....	50,706
3 Bay Furnace [†]	7,883	2,720	3,447	6,524	4,615	.....	.....	.....	25,139
1 Deer Lake Iron Company [†]	1,610	4,954	1,138	3,238	10,910	10,514	6,856	.....	39,270
1 Marquette & Pacific R. M. Co. [†]	7,890	3,546	.....	.....	.....	.....	11,346
1 Grand Furnace [†]	1,431	.....	1,272	3,170	4,464	10,333
1 Carp River Iron Company .....	.....	115	509	4,702	6,780	4,820	3,647	2,350	25,596
1 East Furnace .....	.....	.....	2,175	5,803	1,230	.....	.....	.....	8,008
2 Menominee Iron Company	19,018	3,551	4,848	3,431	8,350	10,280	10,637	10,331	80,641
2 Escanaba Furnace Company .....	.....	4,886	3,696	6,219	8,350	.....	.....	.....	59,993
3 Bangor Furnace Company	33,752	4,836	4,553	2,019	2,400	3,472	4,438	4,983	70,353
6 Peninsula Iron Company	60,000	2,078	3,572	519	2,255	3,000	2,900	.....	8,000
7 Eureka Furnace .....	.....	.....	46,230	3,963	4,061	7,100	11,925	11,310	13,917
8 Frankfort Furnace .....	.....	.....	4,001	3,895	8,053	1,580	.....	.....	44,231
8 Elk Rapids Furnace	39,494	4,731	.....	3,895	4,831	.....	4,805	1,040	61,350
6 Detroit & L. S. Iron M'f'g Co.	443,306	75,310	99,735	114,563	107,650	82,774	70,097	53,653	1,045,148

- 1 Furnaces in Marquette County.
- 2 Furnaces in Delta County.
- 3 Furnaces in Schoolcraft County.
- 4 Furnace in Menominee County.
- 5 Furnaces in Van Buren County.
- 6 Furnaces in Wayne County,
- 7 Furnace in Leelenaw County.
- 8 Furnace in Benzie County.
- 9 Furnace in Antrim County.

*Swineford's History.

†Previous to 1874.

*Coal or Coke.

Caseville Furnace—no returns.

Union Furnace—no returns.

Ward Furnace—no returns.

*Hamtramack Furnace—not in blast since 1873.

*Comparative Statement Exhibiting the Number of Vessels Engaged in the
Coastwise and Foreign Trade with their Tonnage Which Have Entered into and
Cleared from the Customs District of Superior.*

YEAR.		ENTERED.				Cleared.			
		NUMBER.	TONNAGE.	TOTAL.		NUMBER.	TONNAGE.	TOTAL.	
				NUMBER.	TONNAGE.			NUMBER.	TONNAGE.
1871	Coastwise Trade	2,177	829,844	2,300	867,082	2,186	838,101	2,300	880,458
1872	Foreign	123	37,248			114	33,357		
1873	Coastwise	2,226	829,388	2,428	883,206	2,221	824,272	2,406	881,320
1874	Foreign	183	63,878			175	57,048		
1875	Coastwise	2,154	801,761	2,363	961,117	2,186	918,288	2,374	974,157
1876	Foreign	199	59,386			178	55,859		
1877	Coastwise	1,847	808,021	2,069	936,119	1,850	890,745	2,062	948,394
1878	Foreign	222	69,498			212	67,649		
1879	Coastwise	1,790	859,552	2,026	950,046	1,790	879,352	2,031	977,667
1880	Foreign	238	90,496			232	88,315		
1881	Coastwise	1,650	804,612	1,963	886,520	1,639	808,754	1,983	895,110
1882	Foreign	303	90,008			294	88,356		
1883	Coastwise	1,520	804,573	1,839	906,880	1,502	806,080	1,827	908,824
1884	Foreign	319	104,367			325	102,794		
1885	Coastwise	1,861	905,909	2,307	1,137,322	1,873	973,577	2,314	1,145,518
1886	Foreign	446	171,513			441	171,941		
Totals.		17,275	7,548,374	17,275	7,548,374	17,247	7,600,448	17,247	7,600,448

NOTE.—Vessels which have plied between lower Lake ports and other districts, though calling at ports in this district, are not included in the above statement.

Statistics of the St. Mary's Canal, Compiled from Superintendent's Official Report.

	1877.	1878.
Gross Tonnage - - -	1,439,215	1,667,136
Tolls collected - - -	\$42,730	\$49,437
Annual expenses - - -	19,750	25,099
Net profit derived by State of Michigan	22,980	23,338

The commercial importance of the canal may be illustrated by the following leading items of freight passing through it.

UP FREIGHTS.

	1877.	1878.
Coal, tons, - - -	91,575	91,856
Oil, bbla., - - -	6,694	5,135
Lime and Cement, bbls., - - -	9,810	13,180
Live stock, head, - - -	6,924	4,509
Machinery, tons, - - -	1,125	885
Nails, kegs, - - -	22,168	33,514
Spikes, kegs, - - -	4,500	10,330
Railroad iron, tons, - - -	15,854	22,912
Salt, bbls., - - -	63,188	63,520
Sugar, bbls., - - -	27,908	21,856
Passengers, - - -	13,770	13,345

DOWN FREIGHTS.

	1877.	1878.
Wheat, bushels, - - -	1,349,738	1,872,940
Flour, bbls., - - -	334,949	327,984
Iron ore, gross tons, - - -	568,082	555,750
Pig iron, gross tons, - - -	20,375	7,193
Copper, tons, - - -	16,767	22,529
Silver ore and bullion, tons, - - -	999	767
Fish, half bbls., - - -	21,918	10,511
Wool, lbs., - - -	70,830	349,258
Passengers, - - -	8,030	7,049

PORT OF BAYFIELD, WISCONSIN.

ARRIVAL AND DEPARTURE OF VESSELS.

	ARRIVALS.			DEPARTURES.		
	No.	Tonnage.	Crews.	No.	Tonnage.	Crews.
Steamers.....	475	13,550	.....	475	13,550	.....
Sail craft.....	50	410	.....	50	410	.....
Total.....	525	13,960	.....	525	13,960	.....

OUTWARD TRAFFIC.

ARTICLES.	UNIT OF QUANTITY.	AMOUNT.	VALUE.
Bark.....	Cords	151	\$ 755.00
Berries.....	Bushels	145	290.00
Fish.....	Pounds	738,100	22,143.00
Lumber.....	Feet	1,516,000	12,128.00
Wood.....	Cords	450	1,125.00
Fresh Fish.....	Pounds	128,000	3,840.00
Fish oil.....	Barrels	38	570.00
			\$40,851.00

INWARD TRAFFIC.

Apples.....	Barrels	260	\$ 520.00
Cattle and sheep.....	Number	46	2,000.00
Coal.....	Tons	50	300.00
Dry Goods.....	Pounds	17,290	15,000.00
Flour.....	Barrels	1,140	6,270.00
Groceries.....	Pounds	196,660	19,000.00
Hay.....	Tons	15	150.00
Hogs.....	Number	4	80.00
Horses.....	Number	4	400.00
Lime and cement.....	Barrels	100	150.00
Miscellaneous.....	Pounds	153,100	8,000.00
Nails.....	Pounds	9,400	300.00
Oil.....	Barrels	53	291.50
Provisions.....	Pounds	150,924	13,000.00

Salt.....	Pounds	265,360	1,577.50
Stoves.....	Number	51	765.00
Whisky.....	Barrels	30	2,500.00
Beer.....	Cases	266	798.00
			<hr/>
			\$71,102.00

PORT OF EAGLE HARBOR, MICHIGAN.

OUTWARD TRAFFIC.

ARTICLES.	UNIT OF QUANTITY.	AMOUNT.	VALUE.
Copper, mass.....	Pounds	1,244,894	
Copper, barrel.....	Pounds	2,367,338	
Fish.....	Pounds	10,100	
Fuse.....	Pounds	891	
Hides.....	Pounds	38,671	
Household Goods.....	Pounds	66,570	
Iron, scrap.....	Pounds	10,638	
Merchandise.. ..	Pounds	39,786	
Miscellaneous.....	Pounds	56,551	
Posts.....	Number	645	
Rags.....	Pounds	10,812	
Sacks and Bags.....	Number	4,300	

INWARD TRAFFIC.

Apples.....	Barrels	1,128
Blinds.....	Number	108
Cattle and sheep.....	Number	522
Coal.....	Tons	220
Dry goods.....	Pounds	43,996
Doors.....	Number	147
Feed.....	Pounds	553,864
Flour.....	Barrels	2,192
Groceries.....	Pounds	331,575
Grain.....	Pounds	901,770
Hay.....	Tons	65
Hogs.....	Number	198
Horses.....	Number	3

Iron bar and steel.....Pounds	96,522
Lumber and timber.....Feet	207,940
Lath.....M	35
Shingles.....M	57
Leather... ..Pounds	3,777
Lime and cement.....Barrels	374
Machinery.....Pounds	126,902
Miscellaneous.....Pounds	98,603
Nails.....Pounds	28,938
Oil.....Barrels	147
Provisions.....Pounds	223,332
Potatoes.....Pounds	80,019
Sash.....Number	302
Salt.....Pounds	72,820
Stoves.....Number	11
Vegetables.....Pounds	84,425
Whisky.....Barrels	18
Wine and beer.....Barrels	359
Candles.....Pounds	52,885
Hardware.....Pounds	108,056
Boots and shoes.....Pounds	10,698
Windows.....Number	144
Mouldings.....Number	3,207

PORT OF L'ANSE.

ARRIVAL AND DEPARTURE OF VESSELS.

	ARRIVALS.			DEPARTURES.		
	No.	Tonnage.	Crews.	No.	Tonnage.	Crews.
Steamers	24	15,787	338	26	16,565	362
Sail craft	24	14,073	202	24	14,073	202
Total.....	48	29,860	540	50	30,638	564

OUTWARD TRAFFIC.

ARTICLES.	UNIT OF QUANTITY.	AMOUNT.	VALUE.
Fish.....	Pounds	50,000	
Iron ore.....	Tons	41,000	\$225,000
Lumber.....	Feet	7,500,000	

INWARD TRAFFIC.

Apples.....	Barrels	688
Cattle and sheep.....	Number	6
Coal.....	Tons	762
Dry goods.....	Pounds	4,440
Doors.....	Number	50
Feed.....	Pounds	27,929
Flour	Barrels	360
Groceries.....	Pounds	119,887
Grain.....	Pounds	202,533
Hay.....	Tons	86
Horses.....	Number	3
Iron bar.....	Pounds	4,500
Lime and cement.....	Barrels	40
Miscellaneous.....	Pounds	55,860
Nails.....	Pounds	5,500
Oil.....	Barrels	67
Provisions.....	Pounds	134,580
Potatoes	Pounds	37,770
Salt.....	Pounds	2,400
Whisky.....	Barrels	30
Wine and beer.....	Barrels	14

PORT OF MARQUETTE, MICH.

ARRIVAL AND DEPARTURE OF VESSELS.

	ARRIVALS.			DEPARTURES.		
	No.	Tonnage.	Crews.	No.	Tonnage.	Crews.
Steamers.....	412	393,401	9,051	410	392,264	9,046
Sail craft	369	216,444	2,947	375	221,074	3,001
Total.....	781	609,845	11,998	785	613,338	12,047

OUTWARD TRAFFIC.

ARTICLES.	UNIT OF QUANTITY.	AMOUNT.	VALUE.
Berries.....	Bushels	1,220	\$ 2,440.00

Copper, barrel.....Pounds	4,000	640.00
Flour..... Barrels	21	126.00
Fish..... Pounds	220,240	6,607.20
Furniture.....Pounds	7,850	1,200.00
Fuse..... Pounds	2,400	720.00
Ganister.....Tons	3,700	5,425.00
Grain.....Pounds	328,220	3,282.20
Hay..... Tons	2	32.00
Hides.....Pounds	53,820	4,305.60
Horses.....Number	6	750.00
Household goods.....Pounds	170,280	8,514.00
Hardware.....Pounds	35,865	7,173.00
Iron, bar.....Pounds	20,365	509.13
Iron, scrap.....Pounds	981,556	14,723.34
Iron ore.....Gross tons	552,127	2,760,635.00
Iron, pig.....Gross tons	8,586	180,306.00
Lumber .....Feet	2,869,816	34,437.00
Machinery .....Pounds	32,245	3,224.50
Merchandise.....Pounds	141,540	7,077.00
Miscellaneous.....Pounds	410,270	20,513.50
Provisions.....Pounds	33,050	2,644.00
Powder and other explosives.....Pounds	413,700	48,825.00
Stoves.....Number	30	900.00
Stone.....Tons	2,512	26,375.00
Tallow .....Pounds	49,728	3,978.24
Apples, green.....Barrels	11	27.50
Apples, dried.....Pounds	350	28.00
Butter.....Pounds	850	12.75
Barrels, empty beer.....Number	410	307.50
Barrels, empty oil.....Number	873	523.80
Carriers, egg.....Number	658	493.50
Carboys, empty.....Number	1,400	1,400.00
Furs.....Pounds	1,950	3,900.00
Hair.....Barrels	2	5.00
Lime.....Barrels	1,641	2,051.25
Leather.....Pounds	4,600	920.00
Nails.....Kegs	27	68.50
Oil.....Barrels	47	705.00
Potatoes (187 bushels)Pounds	11,220	112.00
Rail, old, gross tons		

590.....Pounds	1,322,958	8,858.00
Rags.....Pounds	16,170	323.40
Salt.....Barrels	25	50.00
Whisky.....Barrels	51	5,100.00
Timber, hewn.....Cubic feet	800,380	88,041.80

INWARD TRAFFIC.

Apples.....Barrels	6,202	\$ 12,404.00
Bark.....Cords	83	664.00
Blinds.....Number	92	138.00
Cattle and sheep.....Number	344	12,040.00
Coal.....Tons	16,987	93,428.50
Dry goods.....Pounds	498,527	199,410.80
Doors.....Number	18	27.00
Feed.....Pounds	891,748	8,917.48
Flour.....Barrels	3,243	19,458.00
Groceries.....Pounds	5,268,773	421,501.84
Grain.....Pounds	347,122	3,471.22
Hay.....Tons	1,866	22,832.00
Hogs.....Number	186	1,860.00
Horses.....Number	26	3,900.00
Iron bar.....Pounds	480,967	12,024.17
Iron, scrap.....Pounds	80,000	1,200.00
Lumber.....Feet	1,450	17.40
Leather.....Pounds	1,380	110.40
Lime and cement.....Barrels	2,012	4,024.00
Machinery.....Pounds	859,630	85,963.00
Miscellaneous.....Pounds	222,810	
Malt.....Pounds	35,800	400.00
Nails.....Pounds	179,962	3,599.24
Oil.....Barrels	1,918	28,770.00
Provisions.....Pounds	311,360	24,908.80
Potatoes.....Pounds	51,660	516.60
Powder and other explosives.....Pounds	477,590	119,397.50
Sash.....Pounds	1,270	100.00
Salt.....Pounds	321,900	3,219.00
Stoves.....Number	168	2,510.00
Vegetables.....Pounds	133,197	3,995.91

Whisky.....	Barrels	427	42,700.00
Wine and Beer.....	Barrels	650	6,741.00
Wood.....	Cords	450	1,377.00
Wagons.....	Number	7	700.00
Boots and shoes.....	Pounds	25,300	25,300.00
Brick.....	M	34	238.00
Cider.....	Barrels	120	600.00
Car wheels.....	Pounds	198,570	9,928.50
Fruit.....	Pounds	12,240	979.20
Gas pipe.....	Pounds	63,680	3,184.00
Furniture.....	Pounds	39,340	1,181.20
Household goods.....	Pounds	33,100	1,655.00
Hardware.....	Pounds	120,140	24,028.00
Iron, R. R.....	Tons	150	5,250.00
Mouldings.....	Pounds	1,710	51.30
Steel.....	Pounds	71,695	9,320.35
Stone.....	Pounds	91,970	45.98
Sand.....	Pounds	200,000	800.00
Splices, R. R.....	Pounds	11,950	358.50
Copper in barrels.....	Pounds	2,500	400.00
Slabs.....	Cords	250	625.00
Kegs.....	Number	2,000	1,500.00
Fuse.....	Pounds	18,000	5,400.00
Brimstone.....	Pounds	45,000	1,575.00
Soda, nitrate of.....	Pounds	600,000	21,000.00
Pitch.....	Pounds	15,000	150.00

PORT OF PORTAGE LAKE.

ARRIVAL AND DEPARTURE OF VESSELS.

ARRIVALS.				DEPARTURES.			
	No.	Tonnage.	Crews.	No.	Tonnage.	Crews.	
Steamers.....	203	183,030	.....	203	183,030	.....
Steam barges..	27	21,238	.....	27	21,238	.....
Sail craft.....	39	19,970	.....	39	19,970	.....
Total.....	269	224,238	.....	269	224,238	.....

OUTWARD TRAFFIC.

ARTICLES.	UNIT OF QUANTITY.	AMOUNT.	VALUE.
Copper, ingot, (refined copper).....	Pounds	28,395,368	
Copper, barrel (mineral copper).....	Pounds	9,347,733	
Lumber.....	Feet	2,593,613	
Lath.....	M	35	
Pickets.....	M	25	
Shingles.....	M	157	

INWARD TRAFFIC.

Coal.....	Tons	34,605
Lime and Limestone...	Tons	4,761
Miscellaneous, mdse., machinery, provis- ions and mining sup- plies, &c., not other- wise specified.....	Tons	17,000
Powder and other ex- plosives.....	Tons	350

PORT OF ONTONAGON, MICH.

ARRIVAL AND DEPARTURE OF VESSELS.

ARRIVALS.			DEPARTURES.		
	No.	Tonnage. Crews.	No.	Tonnage. Crews.	
Steamers.....	123	76,260 2,798	123	76,260 2,798	
Sail craft.....	6	770 25	6	770 25	
Total.....	129	77,030 2,823	129	77,030 2,823	

OUTWARD TRAFFIC.

ARTICLES.	UNIT OF QUANTITY.	AMOUNT.	VALUE.
Copper, mass.....	Pounds	300,120	
Copper, barrel.....	Pounds	1,217,880	
Fish.....	Pounds	1,000	
Hay.....	Tons	142	
Hides.....	Pounds	11,400	
Lumber.....	Feet	4,000,000	
Miscellaneous.....	Pounds	120,500	
Shingles.....	M	3,000,000	

INWARD TRAFFIC.

Apples.....	Barrels	554
Cattle and sheep.....	Number	124
Coal.....	Tons	52
Flour.....	Barrels	3,305
Grain.....	Pounds	571,200
Hogs.....	Number	81
Horses.....	Number	11
Lumber.....	Feet	24,000
Lime and cement.....	Barrels	135
Miscellaneous.....	Pounds	1,462,960
Powder and other ex- plosives.....	Pounds	21,000
Salt.....	Pounds	57,190
Whisky.....	Barrels	39
Pork.....	Barrels	512
Sugar.....	Barrels	350

PORT OF SAULT DE STE. MARIE.

ARRIVAL AND DEPARTURE OF VESSELS.

ARRIVALS.			DEPARTURES.		
No.	Tonnage.	Crews.	No.	Tonnage.	Crews.
Steamers 625	7,812	620	.....	7,813

Sail craft 507	2,535	507	2,535
Total, 1,132	820,556	10,347	1,132 820,558 10,348

OUTWARD TRAFFIC.

ARTICLES.	UNIT OF QUANTITY.	AMOUNT.	VALUE.
Berries	Bushels	5,000	10,000.00
Cattle	Number	84	3,500.00
Coal	Tons	1,000	3,750.00
Fish	Pounds	1,515,000	45,450.00
Grain	Pounds	120,000	1,910.00
Hay	Tons	250	3,500.00
Hides	Pounds	1,000	60.00
Horses	Number	35	1,750.00
Household goods....	Pounds	12,610	5,000.00
Iron, scrap	Pounds	184,000	920.00
Lumber, b'd-measure,	Feet	15,820,000	224,000.00
Merchandise }	....Pounds	600,000	20,000.00
Miscellaneous }			
Pickets	Number		12,500.00
Posts, Cedar and Tele-			
graph,	Number	300,000	25,000.00
Railroad ties	Number	200,000	50,000.00
Silver ore	Pounds	4,000	5,000.00
Tallow	Pounds	10,000	300.00
Wood	Cords	10,000	25,000.00
Lath	M.	2,000	3,000.00

INWARD TRAFFIC.

Apples	Barrels	654	\$ 1,308.00
Blinds	Number	360	500.00
Cattle and sheep	Number	453	18,565.00
Coal	Tons	9,500	27,000.00
Dry goods	Pounds	168,000	33,375.50

Doors.....	Number	282	585.00
Feed.....	Pounds	219,000	2,190.00
Fish, salt and fresh..	Pounds	468,000	12,500.00
Flour.....	Barrels	4,100	20,000.00
Groceries.....	Pounds	699,791	25,000.00
Grain.....	Pounds	1,410,685	10,000.00
Hay.....	Tons	449	5,000.00
Hogs.....	Number	138	600.00
Horses.....	Number	64	5,000.00
Iron bar, Iron scrap,			
Hardware, Stoves.	Pounds	237,848	15,000.00
Lumber dressed....	Feet	70,000	1,200.00
Leather	Pounds	1,500	1,500.00
Lime and cement...	Barrels	1,481	1,850.00
Machinery.....	Pounds	396,006	25,000.00
Miscellaneous mer-			
chandise.	Pounds	1,695,292	50,000.00
Malt....	Pounds	250	5.00
Nails.....	Pounds	150,000	3,700.00
Oil.....	Barrels	437	8,740.00
Provisions....	Pounds	1,167,693	77,538.50
Potatoes.....	Pounds	19,140	1,800.00
Powder and other			
explosives.....	Pounds	1,000	250.00
Sash.....	Number	1,700	850.00
Salt.....	Pounds	338,000	1,000.00
Vegetables	Pounds	138,000	3,214.00
Whisky.....	Barrels	287	28,700.00
Wine and beer....	Barrels	934	8,572.00
Wood.....	Cords	3,100	7,750.00
Broom corn....	Pounds	18,500	555.00
Brick.....	M	400	2,000.00
Lead.....	Pounds	3,512	200.00
Emigrants effects &			
farm implements.	Pounds	140,000	15,000.00
Stone for St. Mary's			
Falls ship canal..	Tons	40,000	156,000.00
Stone, general for			

building.....	Pounds	464,000	1,000.00
Wool.....	Pounds	900	180.00

Reports have only been received from Bayfield, Eagle Harbor, L'Anse, Marquette, Portage Lake, Ontonagon and Sault Ste. Marie. At the time of going to press, no reports of the Lake Commerce of the ports of Ashland, Copper Harbor, Eagle River, Grand Marais, Isle Royale, Lake Linden, Munising, Tequamenon Bay, Whisky Bay and Whitefish Point, had been received; accordingly the preceding reports do not fully represent the commerce of Lake Superior.

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